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THE NEW SOIL SCIENCE[1]

By Dr. P. E. BROWN

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SOIL science or pedology, as it is now coming to be called, is not new. It is centuries old, as may be readily deduced from an examination of many old books and records. Recently, however, the study of soils has taken on a different aspect and we now have a new concept of soil science. It is this modern, rather recent development of the subject which is referred to as "the new soil science."

As is the case with many of our present-day sciences, the beginnings of soil science lie buried in the dim mists of antiquity. Just when and where it might be said to have originated can not be determined. Perhaps the first observations were made in the Garden of Eden. The writings of Moses indicate that agriculture is as old as man. Isaac and Jacob certainly knew how to grow good crops and they probably gathered many facts about soils. Observations on soils certainly have been made from the time man began to learn the art of using them for the production of crops.

According to Herbert Spencer, *use* is the underlying cause of the development of all science. In the early stages, the practical phases always receive the most attention, because of the struggle by man toward the utilization of nature. This has been particularly true, and naturally so, in the case of the various agricultural sciences.

But there is another force which is perhaps even more powerful than use in bringing about the evolution of sciences. It is the "unconscious struggle of our natures for the acquisition of abstract knowledge or for the discovery of the laws of phenomena." In any branch of science, this force soon becomes the more significant, and the present status of knowledge

[1] Address of the retiring president of the Iowa State Chapter of Sigma Xi.

along most lines is due primarily to the efforts of those who have attempted to formulate the laws of nature.

In the development of soil science these two causes have operated continuously and often along parallel lines. There is frequently much overlapping, as might be expected, and it is apt to be quite difficult if not absolutely impossible to determine whether this or that discovery or deduction has come from curiosity or from practical need.

How much knowledge of soils was accumulated in ancient times because of the motivation afforded by the need of the utilization of land for the best crop growth and by the desire of man to penetrate the mysteries of nature is a matter of pure speculation. The early records indicate considerable previous knowledge but throw little light on the extent of this knowledge.

According to Jariloff soil descriptions were already in existence in the seventh century before Christ, but for many succeeding years the study of soils centered mainly around utilization and the scientific aspects of the subject were largely overlooked.

The early Roman literature is filled with observations on soils and speculations on the significance of soil conditions. The works of Cato, Varro, Vergil and Columella are replete with discussions of soil management problems which are much the same to-day as then. Columella attempted to determine the value of soils by determining the sweetness and fatness of plants growing on them. Cato classified soils on their varying capacities for the production of certain plants, not on their characteristics. Many others among these early writers note the wide differences in soils and comment on the relationship of these variations to crop growth.

Not until the beginning of the nineteenth century was there any definite scientific curiosity manifested concerning the characteristics of the soil, and even at the close of that century there was a wide diversity of opinion regarding the field or object of soil science. There was still a tendency to consider the study of soils merely as an adjunct to a knowledge of plant growth and the production of crops. Soils were considered merely as media upon which plants grow or as geological formations with minor modifications.

In spite of the limitations placed upon the science by such fallible, irrational and unscientific bases for the study of soils, there has been a vast accumulation of facts which, in the light of our present knowledge and of the information which is now being secured, can be properly arranged and evaluated for the formulation of those definite laws which must form the basis of any true science.

The new concept of soils involves a consideration of them "in their genetic and geographic relationships." This means that they must be looked upon not merely as geological formations, as surface deposits, as crop producers or as nutrient media for plants, but as definite, distinct entities, recognizable and separable because of certain characteristics which are inherent in themselves. In other words it has been recognized that soils should be studied *as soils*. To do this there must be developed a systematic scheme of classification, for the first step necessary in the scientific study of the objects concerned in any science is to devise a grouping system. Like other objects, too, soils must be grouped or classified on the basis of some definite characteristics. Recent advances in knowledge and more especially changes in view-point have pointed the way toward a scientific grouping of soils, and it is now possible to classify them in what is believed to be a rather permanent way. The modern concept of soils emphasizes the soil type as the unit basis upon which all scientific study must be carried out.

The soil type, then, is now recognized as the final unit in soil classification. The term is not new, but the bases upon which types are differentiated are now more definite and more scientific. The study of the classification of soils and the establishment of more or less fixed criteria for distinguishing and describing soil characteristics and therefore defining soil types has made it possible now, for the first time in the history of soil science, to lay a solid foundation of fact upon which a permanent superstructure may be erected.

Many attempts to classify soils have been made in the past and various schemes have been suggested. One of the earliest was based on texture, differentiating clays, sands, loams and sandy loams. Humus soils and limy soils were also included in this grouping. The geological origin of soils has been used quite extensively as a grouping basis, distinguishing soils derived from limestone rocks, from feldspathic rocks or from granitic rocks. The location or origin of the soil was the basis for another grouping, residual, alluvial and "occasional" soils being separated. There was also a chemical classification, silicate, carbonate and sulphate soils being differentiated. More recently classifications have been suggested on the basis of color, vegetation (*e.g.*, forest, and prairie soils), temperature (recognizing tropic, temperate and arctic soils) and moisture (separating arid, semiarid and humid soils).

The Russian pedologists have contributed much to our knowledge of the classification of soils. Glinka has summarized the earlier work, much of which was inaccessible to us until his book appeared. The names

of Thaer, Fallou, Dokutschajeff, Von Richthofen, Sibirceff and Wyssotzkie stand out prominently among the many who have attempted to classify soils. Glinka himself purposed a classification based mainly on moisture conditions under which the soils have developed. He distinguished Endodynamomorphic soils, or transition soils, in which the influence of the properties of the parent rock predominate and which may change independently of external conditions, and Ektodynamomorphic soils, in which the climatic factors exert the most effect. This latter group he subdivides into six subgroups, depending upon the moisture conditions under which the soils are developed.

More important, however, than any of the other ideas put forth by the Russians was that of examining soils by horizons and profiles, in other words, of studying the characteristics of the soil itself, by layers. The soil profile is the vertical section of the soil from the surface to the underlying unweathered material. The soil horizon is the layer or section of the soil profile more or less well defined, occupying a position parallel to the soil surface. Three definite layers or horizons are recognized, called the A, B and C horizons. The A horizon is the surface soil, the B horizon the subsoil and the C horizon the substratum. Subdivisions are made in these horizons when necessary, calling them A_1, B_2, etc.

Marbut, of the Bureau of Soils of the U. S. Department of Agriculture, utilizing many of the Russian suggestions and profiting by the mass of other work on soils which is extant, has developed a system of classification which permits of a rational, scientific and permanent grouping—a grouping of objects which is comparable to those followed in other sciences.

According to this plan the soil type is separated on the basis of the profile characteristics, and this includes, of course, the characteristics of the various horizons. The following features are determined for a type separation:

(1) Number of horizons in the soil profile.
(2) Color of the various horizons.
(3) Texture of the horizons.
(4) Structure of the horizons.
(5) Relative arrangement of the horizons.
(6) Chemical composition of the horizons.
(7) Thickness of the horizons.
(8) Thickness of the true soil.
(9) Character of the soil material.
(10) Geology of the soil material.

It may be noted how all the earlier ideas on soil classification have been embodied in the present system but have been subordinated to the more important idea of determining the characteristics of the soil horizon.

A soil type may then be defined as a soil which, wherever it occurs, has a relatively uniform texture of the surface soil and relatively uniform profile characteristics.

The soil type is the species.

Soil types are grouped into *series* when all the characteristics are the same except the texture of the surface soil.

The soil series is the *genus*.

Soil series having certain similar profile characteristics are further grouped into *families*.

A final grouping of *families* into soil *orders* is indicated as a future possibility, perhaps based on the occurrence or absence of a zone of carbonate accumulation.

Soil types are given a compound name, one part of which indicates the profile characteristics, the other the texture of the surface soil. The first is the series name. Thus there is the Carrington loam, the Webster loam, the O'Neill loam, each belonging to different series but having the same surface texture. There are also the Carrington sandy loam, the Carrington fine sandy loam, the Carrington sand, and so on, all belonging to the same series but differing in texture of the surface soil.

The series name is an arbitrary designation, it is true, but that can hardly be objected to, inasmuch as arbitrary terms have been fixed for the objects involved in all branches of science.

Names have not been devised, as yet, for the various soil families or for the soil orders. Undoubtedly, in the future, arbitrary terms will be selected for these soil groups.

In the short time which has elapsed since soils have been classified, named and mapped on this basis, there has developed a wide-spread appreciation of the value of the system. Not only has it come into use scientifically but it is also proving to be of much practical value. The new concept of soils, then, is not a mere scientific curiosity; it is of practical importance.

Time will not permit of an extended consideration of the significance of the modern concept of soils to all phases of soil investigations or to practical agriculture.

Sufficient information is available, however, to show that any study on soils must be carried out by types or the results will be of little value. Any systems of management, to be of practical importance, must be worked out for soil types. The conclusion drawn from the results secured on one soil type may not be at all applicable to another type. The system of treatment found to give increased crop yields on one type may fail utterly to benefit the crop on another type. Field experiments in Iowa have shown

that even the most common fertilizing materials will have varying effects on the different soil types.

Much of the work of the past has been carried out with a complete disregard of the particular soil conditions; the results of field experiments, greenhouse tests and laboratory investigations have been quite generally interpreted as applicable to all soils. While extreme differences in soils, such as occur between sands and clays, were recognized, there was a decided tendency to look upon "any soil as soil." An examination of the voluminous soils literature of the past will bear out this statement. For example, the results secured by one investigator may not be checked by another, and each, then, may privately suspect the other of inaccurate work, even if they do not go as far as to engage in a polemical dispute in some scientific journal. The Bureau of Soils' toxic theory of soil fertility, the acid phosphate-rock phosphate dispute, the character of soil acidity, the cause of soil infertility, the protozoal theory of the Rothamsted investigators, the plant disease theory of Bolley and a host of other interesting and important questions have not been settled because it has been attempted to dispose of them without regard to the soil types involved.

There are, of course, certain principles which may be found to be applicable to all soil types, to all soil series, to all soil families or to all soil orders, but they can not be accepted as applicable by mere assumption. Investigations must be carried out on each type. Obviously, such principles can not be enunciated, therefore, for many years to come. Not even for a limited area will it be possible to lay down laws until investigations have been continued over a long period of time. There are over two hundred soil types now mapped in Iowa, and before the survey of the state is completed there will be many more. In the United States there will undoubtedly be many thousands of types.

But soil investigators are not at all alarmed by the amount of work which is thus indicated to be ahead of them. Rather are they enthusiastically accepting the "new soil science" and planning and carrying out their work on the modern basis, knowing that their results will not be misinterpreted, will not be discarded because of being inapplicable to all soils and will not be merely an evidence of wasted effort. They can be confident that they are adding to the sum total of human knowledge and eventually in the distant future they will have played their part, contributed their quota toward the establishment of the principles and laws of soil science.

While the investigations of the past have added much to the present-day knowledge of soils, the studies of the present are accumulating facts upon which laws can be formulated. The modern concept of soil science has literally brought all soils work "down to earth," and the future can be faced with confidence. No more will there be any question of whether or not soil science is a real science. No more will investigations be criticized on the basis of being inapplicable to all soils. Work on one soil type will be recognized as of value. The "new soil science" is scientific; it is distinct; it is permanent, and, finally, it is definitely and undisputably agriculturally practical.

RECENT PROGRESS IN THE HISTORY OF ANCIENT MATHEMATICS[1]

By Professor LOUIS C. KARPINSKI
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Not much more than one hundred years ago the united efforts of a large group of European scholars unraveled the mysteries of the Egyptian hieroglyphics and hieratic characters, and only a little while thereafter in a somewhat analogous manner the mysteries of the Babylonian cuneiform writing were revealed. By these efforts two absolutely dead languages were placed among the living languages of the world of scholarship. These achievements must always be accounted among the greatest accomplishments of the human intellect, restoring Egypt and Babylon to participation in the telling of the history of by-gone ages.

In the early days of Egyptology the Rhind mathematical papyrus was discovered and translated, based upon the recently deciphered hieratic writing. In Babylon the tablets of Senkereh, with tables of squares and cubes, gave a significant bit of material about Babylonian mathematics. In both instances these were accidental documents whose preservation and discovery were somewhat a matter of chance.

Concerning certain developments of Greek mathematics particularly with respect to the development of arithmetic and algebraic ideas the information available has long been fragmentary and to some ex-

[1] Address delivered before the Michigan Education Association Institute, Ninth District, Mathematics Section, October 28, 1929.

tent unsatisfactory, largely, doubtless, because the histories of mathematical subjects written about the time of Aristotle are lost.

Since the dawn of the twentieth century an amazing amount of new material has come to light to increase our knowledge of Egyptian, Babylonian and Greek mathematics. Doubtless the discovery of the lost work of Archimedes, "The Method Treating of Mechanical Problems," is the most significant addition of the period. On the one hand, this discovery indicates that the work of the superlative genius, far in advance of his contemporaries, to a large extent fails because of lack of appreciation and of continuation; on the other hand, the fact that a noteworthy work of a popular genius like Archimedes could vanish indicates that hundreds of documents of men less famous in their own day have absolutely disappeared. The studies of the late Karl Schoy and the studies of Dr. Julius Ruska and others have also added new Greek material through Arabic sources.

Here at the University of Michigan we are able to record the discovery of a notable addition to our information concerning the algebra of Greece.[2] Among the papyri acquired by that indefatigable friend of learning, Professor Francis W. Kelsey, was one of the second century of the Christian era which gives a series of algebraic problems. These form the logical continuation of problems found in Egypt and problems analogous to those of the so-called Greek Anthology, and the problems of Diophantos. This document was translated by Professor Frank E. Robbins, who permitted me to collaborate in a popular exposition of the papyrus appearing in SCIENCE. Another document[3] which has been published from the Michigan collections is in a way of minor importance and yet indicates both the continued Greek use of the unit fractions of the Egyptians and the method of that use.

A new translation and study of the Rhind papyrus has been made by the distinguished Egyptologist, T. Eric Peet,[4] of Liverpool. This work throws much new light on the ancient document. We are even to-day eagerly awaiting the facsimile and translation of this document being published under the sponsorship of the Mathematical Association of America by Chancellor A. B. Chace, of Brown University, with the scholarly assistance of Dr. Ludlow Bull, of the Metropolitan Museum, and Professor H. P. Manning, of Brown University. And even with more impatience we await the complete translation of the Moscow papyrus, by Struve, of Leningrad, which will doubtless throw a wealth of light upon Egyptian mathematics as indicated by the few fragments already published.[5] Touraeff in 1917 gave from this Moscow papyrus the volume of the truncated pyramid as $1/3\ h(a^2+ab+b^2)$, and Struve adds an equally amazing formulation for the surface of a hemisphere as $2\pi r^2$. Heretofore no historian has suspected that the empirical knowledge of these formulas was not the undisputed achievement of Greece. Indeed, concerning the volume of the pyramid Archimedes, himself the reputed discoverer of the second of these theorems, ascribes the first statement of the first theorem to Democritus and its proof to Eudoxus. It is quite probable, also, as I pointed out in my translation of Touraeff's article, that the Moscow papyrus may show that the Greek work given in Euclid's Data on construction of rectangles and application of areas is logically connected with early Egyptian mathematics. Notably the well-known Egyptian problem on the distribution of a square of 100 square units into two equivalent squares whose sides have a given ratio is a beginning along this line, and the Moscow papyrus evidently refers to other similar material.

Only a few months ago the historians of science were delighted to receive the first issue of a new journal in the field of the history of mathematics, *Quellen und Studien zur Geschichte der Mathematik*, edited by O. Neugebauer, of Göttingen, J. Stenge, of Kiel, and O. Toeplitz, of Bonn. The publisher is Julius Springer in Berlin. The amazing nature of the contents of the first issue of this journal has been indicated in SCIENCE by R. C. Archibald.[6] Some time ago I called attention to the notable additions to our knowledge of Babylonian mathematics which were summarized in the work of Bruno Meissner.[7]

In the article of 1929 in the above-mentioned journal and in an article "Über vorgriechische Mathematik"[8] Dr. Neugebauer adds to the available material on the mensuration of circles, of triangles and of trapezoids. However, the most significant and almost revolutionary announcement is the discovery among the early Babylonians of the numerical solu-

[2] L. C. Karpinski and Frank E. Robbins, "Michigan Papyrus 620; The Introduction of Algebraic Equations in Greece," SCIENCE, September 27, 1929, 70: 311–314.

[3] L. C. Karpinski, "Michigan Papyrus No. 621," *Isis*, 5 (1923): 20–25, with plate.

[4] "The Rhind Mathematical Papyrus," Liverpool, 1923.

[5] B. Touraeff, "The Volume of the Truncated Pyramid in Egyptian Mathematics," "Ancient Egypt," 1917, pp. 100–102; L. C. Karpinski, "An Egyptian Mathematical Papyrus in Moscow," SCIENCE, 57 (1923): 528–529. In the article in SCIENCE I pointed out the importance of the other problems to which Touraeff refers. There is a further article on this work, in Russian, by D. Zinserling, "Geometry of Ancient Egypt," *Bulletin* de l'Académie des Sciences de l'U. R. S. S., 19 (1925): 541–568.

[6] *Babylonian Mathematics*, July 19, 1929, 70: 66–67.

[7] "New Light on Babylonian Mathematics," *American Mathematical Monthly*, 33 (1926): 325–326.

[8] Abhandlungen aus dem mathematischen Seminar der Hamburger Universität, Vol. VII, 1929, pp. 107–124.

tion of a type of complete quadratic equation. The more detailed explanation to appear in a later issue of the *Quellen* is awaited with great interest. With this material is also found new material on arithmetical series and on linear and quadratic equations in two unknowns.

When the Rhind papyrus was issued in 1877 by Eisenlohr the announcement was made that an ancient leather roll of mathematical content was also in the possession of the British Museum. Recently, in the *Journal of Egyptian Archaeology*,[9] S. R. K. Glanville has been able to publish the contents, as improved chemical methods made it possible to unroll the document. The material adds definitely to our knowledge of the Egyptian treatment of fractions. A long series of articles on the Egyptian fractions and other phases of the Egyptian mathematics, notably the beginnings of algebra, has appeared within recent times by Wieleitner, Abel Rey, Kurt Vogel, Loria, Neugebauer and others, as well as more detailed discussion in the books by Peet, by Gillain,[10] and in the work of D'Ooge, Robbins and Karpinski.[11] Doubtless in the new edition of the Rhind papyrus by Chancellor Chace, Dr. Archibald will give a somewhat comprehensive summary of the literature to date.

Any summary, however brief, of recent activities in the field of ancient mathematics and science must include a large group of serious comprehensive treatises which contribute largely to the modern view of the ancient learning. First and most important is George Sarton's "Introduction to the History of Science," a veritable mine of information. Then there are the histories by Gino Loria, Aldo Mieli, Sir Thomas L. Heath and J. L. Heiberg which from varying points of view give a survey of the present state of our knowledge and a background for appreciation of the most recent discoveries.

The writer may be pardoned if in closing reference is made to an article "Algebraical Developments among the Egyptians and Babylonians" which appeared in the *American Mathematical Monthly*[12] more than twelve years ago. In this the writer stated that the material then available indicated a high state of development of mathematical thought in Egypt and Babylon before the golden age of Greece. To-day even more than then, when the assertion represented a somewhat new point of view, it is certain that the indebtedness to Babylon and Egypt often explicitly affirmed by Greek writers is no figure of speech, no rhetorical gesture, but rather an assured fact.

9 13, 1927: 232–239.

10 "La Science Egyptienne," "L'arithmétique au moyen empire," Brussels, 1927. xvi and 326.

11 "Nicomachus of Gerasa, Introduction to Arithmetic," Michigan Humanistic Series, Vol. XVI, Chapter I. New York, 1926.

12 L. C. Karpinski, *American Mathematical Monthly*, 24: 257–265.

OBITUARY

VICTOR CLARENCE VAUGHAN

THE death of Victor Clarence Vaughan on November 21, 1929, has deprived American medicine and public health of a great leader. He was born on October 27, 1851, at Mount Airy, Missouri. From 1874 until his retirement in 1921 he was connected with the University of Michigan, first as student, then as teacher and dean, during which long period he achieved for himself a rare reputation as a teacher, scientist and epidemiologist.

Dr. Vaughan went to the University of Michigan in 1874, after having taught Latin for two years at Mount Pleasant College, Missouri, where he graduated in 1872. At Michigan he received four degrees: M.S. in 1875; Ph.D. in 1876; M.D. in 1878, and the honorary degree of LL.D. in 1900. Later, other institutions honored themselves by conferring upon him the honorary degrees of LL.D., Sc.D. and M.D.

Dr. Vaughan was president of the Association of American Physicians in 1908 and of the American Medical Association in 1914. He was a member of the National Academy of Sciences, the American Philosophical Society, the French and Hungarian Societies of Hygiene. He also served as member of the House of Delegates of the American Medical Association in 1902, 1903, 1904 and 1906, and of the Council on Medical Education from 1904 to 1913. He was chairman of the section on pathology and physiology in 1902, of the reference committee on medical education in 1904 and of the Council on Health and Public Instruction from 1919 to 1923.

Dr. Vaughan began his teaching connection with the University of Michigan in 1875, as assistant in the chemical laboratory. In 1879 he became lecturer and in 1880 assistant professor of medical chemistry, and in 1883 he was advanced to the professorship. In 1887 he became professor of hygiene and physiological chemistry and director of the newly established hygienic laboratory. To these duties he added, in 1891, that of dean of the medical school. He held this chair and the deanship until 1921 when he retired as emeritus professor.

Retirement from the university did not close his activities. For several years, as chairman of the Medical Division of the National Research Council, he resided in Washington. It was there he wrote his splendid work, in two volumes, on "Epidemiology and Public Health," and in 1926 he produced his living

autobiography "A Doctor's Memories." In the fall of that year, with Mrs. Vaughan, he went as delegate to the Medical Congress in the Orient, visiting China, Japan and the Philippines. On his return in the spring of 1927 he suffered an attack from which he never fully recovered.

For twenty years following his graduation in medicine Dr. Vaughan was engaged in active medical practice. Nevertheless his interest always centered in laboratory work. From the beginning he was attracted to chemistry, and the chemical view-point appeared prominently throughout his subsequent work. His first modest contribution on the separation of arsenic from other metals appeared in 1875. The action of poisons and their detection fascinated him to such an extent that before long his services were in demand as a medical expert and he became a recognized authority on toxicology.

It was but a step further to become interested in sanitary matters. The question of the pollution of wells and of larger water supplies arose, and a chemical examination at that early period was the only means of arriving at a decision. At this time Dr. Vaughan was called upon to investigate the not infrequent poisonings from cheese and other milk products. Though bacteriology was then in its infancy he soon realized that the poisonous products were in some way the result of bacterial action. He was among the first to teach that similar products could be the cause of cholera infantum and that this disease was therefore due to the contamination of milk. Without his fully realizing it at the time, the sanitary chemical work was leading him into the new and broader field of modern bacteriology.

It was soon apparent that the old chemical laboratory was inadequate for pursuing problems pertaining to health and disease. His broad vision indicated the need of a separate institution. Accordingly, he appeared before the Michigan Legislature of 1887 and secured an appropriation establishing the hygienic laboratory at the university. At this time some attempts were made in the old laboratory to apply the new science of bacteriology to the solution of problems arising in connection with the examination of waters, but it was seen that a thorough training in the new discipline was necessary. At that early period this could be obtained only in Germany. Accordingly, Dr. Vaughan spent the summer of 1888 in Koch's laboratory in Berlin, where under the direction of Carl Fraenkel a first-hand knowledge of the new methods was acquired.

The hygienic laboratory at the university was completed in the fall of that year and opened for work in January, 1889. It was the first laboratory in this country which offered systematic teaching of bacteriology to physicians and students. Before long the laboratory outgrew its quarters and in 1903 it was moved to the new, the present west medical building; since 1926 it has occupied a wing in the east medical building. For twenty years after the opening of the laboratory Dr. Vaughan was active as its director, and it was during this period that a further and important step in extending its service to the state took place. In 1903, on the occasion of the first serious outbreak of rabies in the state, Dr. Vaughan obtained from the Board of Regents authorization to establish a Pasteur Institute as a part of the hygienic laboratory. At that time the antirabic treatment was not given except in two or three places in this country.

Dr. Vaughan's investigations in the new laboratory covered many fields. At first, the examination of water supplies claimed much attention, and in this connection he devised what he termed "the Michigan method" of analysis which made use of the experimental animal as a means of detecting harmful bacteria. His studies on food poisonings were likewise extensive and thorough. He sought the explanation of the germicidal action of normal serum and found it in the complex chemical constituent nuclein. Even more important were his studies upon the nature of the bacterial poisons or toxins. He devised an ingenious "tank" method for growing pathogenic organisms in mass quantities in order to obtain a sufficient amount of the cells for the purpose of studying the bacterial proteins which he was able to break up into two portions, one toxic and the other nontoxic. He utilized these results in formulating a valuable theory bearing upon the nature of hypersensitiveness and of fevers. As an earnest and enthusiastic investigator Dr. Vaughan had few equals. His extraordinary capacity for writing found expression in more than two hundred publications, not including his more pretentious works, on physiological chemistry, on ptomaines and leucomaines, on cellular toxins, on protein split products, on infection and immunity and on epidemiology. As an editor he founded the *Physician and Surgeon,* the *Journal of Laboratory and Clinical Medicine,* and served as the first editor of *Hygeia.* During his thirty years of service on the Michigan State Board of Health he did much to spread the growing knowledge of sanitation and public health.

No mention of Dr. Vaughan's activities would be complete without reference to his services in the army. Intensely patriotic, at the outbreak of the Spanish War he volunteered his services and saw active service at Santiago where he contracted yellow fever. The most deplorable fact in connection with that war was the outbreak of serious disease among the troops in the different concentration camps.

Laboratory methods were non-existent in the camps, and the prevailing disease was called indigestion, malaria or typho-malaria, rarely by its true name—typhoid fever. At the close of the war a commission, consisting of Majors Walter Reed, V. C. Vaughan and E. O. Shakespeare, was appointed to investigate the outbreak. The final report of that commission was prepared by Dr. Vaughan, the only surviving member. It was a classical contribution to the epidemiology of typhoid fever. This report forcibly attracted attention to the necessity of conducting future military campaigns under strict hygienic conditions. In the interval between this and the recent war improved diagnosis and immunization made it possible to avoid this terrible scourge.

Upon our entry into the late war, Dr. Vaughan was again called upon to give his services. As one of the board in charge of the communicable diseases in our camps, he served with ability and distinction, receiving the rank of colonel, the Distinguished Service medal and the decoration of the French Legion of Honor. More recently he was the recipient of the Kober medal. His work during the two wars brought him full recognition as a leading epidemiologist.

As a member of the National Research Council which came into being at the request of President Wilson, Dr. Vaughan participated in the work of that body by his wise counsel and his vast experience.

It is as an instructive and inspiring teacher that Dr. Vaughan will be remembered by the thousands of students who had the opportunity and privilege of listening to him. He freely drew upon his experiences in life and by his masterly presentation made the lectures interesting and forcible.

Unquestionably the greatest service which he rendered to the cause of medical education came during his tenure of the deanship. At the time that he entered this office the new laboratory methods of instruction were just coming into their own. With his clear foresight he recognized the importance of having productive scientific men upon the faculty, and it was this fact which enabled him to get together men of outstanding ability, thus placing the medical school of the university in the front rank of the schools in the country.

Dr. Vaughan's interest in the investigations of his colleagues was not less than that in his own researches. He lived, so to speak, in the laboratory and was never so happy as when a new fact or result rewarded his work. He loved his fellow men and freely gave of his time and energy. As a scientist and educator he was among the first. He has left an enduring impress in both fields. A great leader, a constructive thinker and a broad idealist is gone.

FREDERICK G. NOVY
UNIVERSITY OF MICHIGAN

MEMORIALS

The British Medical Journal reports that a memorial tablet has recently been placed on the house of Dr. Aloys Pollender (1800–79) at Wipperfürth, Westphalia, who described the anthrax bacillus in 1849, a year before C. J. Davaine, who is generally credited with its discovery.

WE learn from the London *Times* that in the City Church of the Ethelburga, Bishopsgate, where Henry Hudson, the navigator, took his last communion, a second window in his memory was unveiled on November 28. The ceremony was performed by Mr. Albert Halstead, the American consul-general in London. The new window, designed and executed by Mr. Leonard Walker, shows Henry Hudson exploring the Hudson in his ship, *The Half-Moon,* and finding some Indians who welcomed his approach. At the base of the window are represented various animals, including the beaver and the skunk, indigenous to North America.

RECENT DEATHS

MATURIN LIVINGSTON DELAFIELD, originally of New York, who for the last twenty-five years has resided in Lausanne, known for his work in botany, died on December 18, at the age of sixty-one years.

DR. SAMUEL RIDEAL, known as a chemist and an expert on sanitary science, died suddenly in Southern Rhodesia, on November 13, at the age of sixty-six years.

DR. AUGUST TOBLER, director of the geological section of the Natural History Museum in Basel, Switzerland, one of the leading European workers on the geology of the East Indies and also of northern South America, died on November 23.

THE death is announced of Professor Angelo Ruffini, professor of histology and general physiology at the University of Bologna.

SCIENTIFIC EVENTS

GOLD, SILVER, COPPER, LEAD AND ZINC IN THE EASTERN STATES

THE total value of the mine production of gold, silver, copper and zinc (value of lead is excluded) in the Eastern States in 1928 was $23,867,816, according to final figures for the year compiled by J. P. Dunlop, of the U. S. Bureau of Mines. There was an increase in both quantity and value of the above metals, al-

though the average price of zinc was lower in 1928 than in 1927.

The quantity of crude ore treated in 1928 was 3,770,070 tons, which was about 569,000 tons more than in 1927. Only about 200 tons of gold ore were treated; the larger portion of the remainder was zinc ore, lead-zinc ore and copper ore sent to concentrating plants. The total quantity of copper ore concentrated and directly melted amounted to 833,325 tons. The pyritiferous magnetic ore of Pennsylvania yielded a large output of copper concentrates containing some gold and silver.

The mine production of gold increased from $17,074 in 1927 to $35,097 in 1928. The gold recovered from placer mines was $820 from small mines in Georgia, North Carolina, South Carolina and Tennessee. There was more development at gold lode mines in 1928 than in 1927. Siliceous ores, all from Georgia and North Carolina, yielded $1,120 in gold; pyritiferous magnetite ore from Pennsylvania yielded $20,506 in gold, and copper ore from Tennessee and North Carolina yielded $10,810 and $1,841 in gold, respectively.

With the exception of 16 ounces, all the silver output (102,501 ounces) in 1928 from lode mines was derived from copper ore and pyritiferous magnetite ore. Tennessee yielded 75,556 ounces, North Carolina 19,040 ounces and Pennsylvania 7,905 ounces. Placers yielded 3 ounces of silver.

The quantity of copper produced increased from 22,327,734 pounds in 1927 to 29,559,146 pounds in 1928. The output from Pennsylvania was 4,977,885 pounds and the remainder was from ore smelted by the Tennessee Copper Co., and the Ducktown Chemical & Iron Co., in Polk County, Tennessee. About half the copper recovered at Tennessee smelters was from copper ore mined and shipped from the Fontana mine in Swain County, North Carolina.

As there was only one shipper of lead ore or concentrates in the eastern states in 1928 the output can not be given. Lead-zinc ore was mined and milled at the Austinville mine of the Bertha Mineral Co., in Wythe County, Virginia.

The mine production of zinc increased from 118,170 tons in 1927 to 144,045 tons in 1928, most of which is derived from zinc ores containing little or no lead. The large producing zinc properties in the eastern states are those owned by the New Jersey Zinc Co., in New Jersey, the St. Joseph Lead Co., in St. Lawrence County, New York, the Bertha Mineral Co., in Wythe County, Virginia, and the American Zinc Co., of Tennessee, at Mascot, Jefferson County, Tennessee. Other shippers of zinc ore, mainly carbonates, in 1928 were the Universal Exploration Co., F. C. Caldwell, and the Embree Iron Co., all of Tennessee.

COLLECTIONS FOR THE FIELD MUSEUM FROM EASTERN ASIA

THE work of the William V. Kelley-Roosevelts Expedition to Eastern Asia for the Field Museum of Natural History has been concluded with the return of Herbert Stevens, leader of the last of its several divisions to remain in the field, according to an announcement made by Stephen C. Simms, director of the museum.

Mr. Stevens is now at the museum supervising the work of unpacking the collections he brought back, comprising some 500 mammals, about 1,100 birds, some 500 reptiles and fishes, approximately 5,000 butterflies, 2,000 moths, 500 beetles and bugs and about 10,000 flowers, plants and shrubs. Many of these are rare species, some unknown to science. These collections were made by him during a little less than a year's journeyings through the Chinese provinces of Yunnan and Szechuan, and along the Tibetan border. In the course of his work Mr. Stevens traveled more than 1,700 miles by trail across China, about 1,000 miles on foot and in addition traveled many miles by water. He was the only white man in his division of the expedition, and headed a caravan of native skinners, porters and other servants, with a train of pack animals consisting sometimes of yaks, but more often of mules and ponies. At times only human porters could be used.

The country which Mr. Stevens traversed is infested with bandits, and inhabited by a half-starved population suffering from the chaotic conditions in China. The journey through this region was fraught with many perils, but Mr. Stevens and his caravan came through all difficulties safely. At one time between camps their food supplies ran short, and for some three weeks they were forced to live on half rations, but by piecing out with food intended for bait in animal traps they were able to tide over until new provisions could be obtained.

Mr. Stevens, who was formerly connected with the British Museum, started into the interior with Colonel Theodore Roosevelt and Kermit Roosevelt, who were in command of the expedition as a whole. He separated from them to perform his special work shortly after entering Yunnan. From then on most of his traveling was done in a mountainous country averaging between 10,000 and 15,000 feet elevation, intersected by many rivers and heavily forested in many places. The larger part of it was in the land of the strange and exclusive Tibetan lamas, who despite their forbidding reputation Mr. Stevens found quite hospitable, though he could never be sure when trouble might arise. It is a land practically untouched by civilization, with no ordinary means of transport or communication, no Christian missionaries and much

of it never before explored by white men. Mr. Stevens was cordially received by several lama kings, who assigned numbers of their subjects to assist him in proceeding from one camp site to another. In several places he stopped overnight under the roofs of lama monasteries.

At one point along the Yalung River, a tributary of the Yangtse, an extraordinary means of crossing had to be employed. There is a gorge here several hundred feet deep, and the only means of getting over is by sliding down an inclined bamboo rope which is stretched across. Men, animals and baggage were fastened into slings and sent flying perilously across by means of a sleeve support which slid along the bamboo rope, their progress being accelerated by the fact that the rope was oiled with butter.

In many villages famine was so rife that when Mr. Stevens and his caravan entered the people would fall on their knees and beg them not to stay more than one night, fearing that they would cause further food shortage.

At one time, while aboard a boat on the Yangtse River, Mr. Stevens and his party were fired upon by soldiers to force them to come into a tax station, but no one was struck by the bullets. To reach Shanghai for embarkation to America, Mr. Stevens had to make a long journey by bamboo raft on the Ya River, and then by Chinese junk and river steamer on the Yangtse.

ELECTRICAL APPARATUS PRESENTED BY COLUMBIA UNIVERSITY TO EDISONIA

MORE than one hundred and ninety pieces of historical electrical apparatus have been presented to Henry Ford by Columbia University for display in Edisonia, the museum Mr. Ford is founding in honor of Thomas Edison at Dearborn, Michigan, according to an announcement recently made by Professor Walter I. Slichter, of the department of electrical engineering.

The gift was authorized by the department of engineering after Mr. Ford had visited it and had personally inspected the collection of old electrical apparatus. It constitutes practically the entire museum formerly housed in the electrical engineering laboratories and collected through the efforts of Dr. Francis Bacon Crocker after he had founded the department of electrical engineering in 1889. Many of the pieces had been particularly desired by Mr. Ford, because of their connection with the early stages of Mr. Edison's work on the electric lamp. Because of lack of space, the apparatus and machinery were not easily available for public inspection in the Engineering Building at Columbia.

Among the most valuable apparatus sent to Dearborn are one of the several Wallace arc light generators now in existence, the two Edison bi-polar generators which supplied Columbia University with electricity when it was located at Forty-ninth Street and Madison Avenue, and the original loading coil invented by Professor Michael I. Pupin at Columbia and destined more than any other single factor to perfect the quality of speech transmitted over telephone lines.

Other important pieces are a die used by Mr. Edison to press out the carbon filaments of his early electric lamps, an Edison chemical ampère-hour meter which was designed to measure current commercially, but it proved to be inaccurate, and three models demonstrating the Edison 3-wire system of the flow of electricity by the analogous flow of water.

Two photographs were included, one an autographed photograph of Mr. Edison and the other a group picture of Mr. Edison, Professor Pupin, Dr. Crocker and C. S. Darling, formerly superintendent of buildings at Columbia. Mr. Darling left the university to become general manager of one of Mr. Edison's laboratories and was killed soon afterwards by an explosion in the plant.

The group picture was one of a series of portraits of famous engineers collected by Professor Morton Arendt, and was relinquished by Professor Arendt after Mr. Edison had agreed to replace it with a new photograph of himself.

Inscribed on the photograph of Mr. Edison is the original version of the inventor's famous paraphrase of Milton. He wrote: "My dear Crocker—a new motto for your boys—they also serve who hustle while they wait." Mr. Edison's admonition has been repeated to thousands of engineering students throughout the country.

After his visit to Morningside Heights, Mr. Ford carried away in his own car several pieces which he especially wanted. They were a 250-watt Edison bi-polar motor, a 1.5 kilowatt Edison bi-polar generator, a 7.5 kilowatt Edison bi-polar generator, the autographed photograph of Mr. Edison, the Wallace arc light generator and an Edison solenoid ammeter.

THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE OF SOUTHERN CALIFORNIA

MEMBERS of the Society for Experimental Biology and Medicine residing in Southern California met recently at the University Club in Los Angeles for dinner, at which time they discussed the advisability of holding meetings at regular intervals. Eleven members were present and gave brief discussions on the following topics of current research:

B. M. Allen, University of California at Los Angeles, Factors that Control Growth and Development in Tadpoles.

O. L. Sponsler, University of California at Los Angeles, Molecular Structure of Protoplasm.

M. S. Dunn, University of California at Los Angeles, Synthesis of Naturally Occurring Amino-acids.

G. H. Ball, University of California at Los Angeles, Life History of Certain Parasitic Marine Protozoa.

M. T. Burrows, Pasadena, California, Relation of Cancer to Infection.

T. W. Vaughan, San Diego, California, Problems of Experimental Biology at Scripps Institute of Biological Research.

H. J. Deuel, Jr., school of medicine, University of Southern California, Metabolism of Cold-blooded Animals.

C. H. Thienes, school of medicine, University of Southern California, Effect of Nicotine on Rats.

M. B. Visscher, school of medicine, University of Southern California, Source of Energy in Muscle Contractions.

R. W. Lamson, school of medicine, University of Southern California, Allergy and Immunity.

J. F. Kessel, school of medicine, University of Southern California, Interrelationship between Intestinal Protozoa and Bacteria.

Other members in the region who were unable to attend the meeting are T. H. Morgan, California Institute of Technology, Pasadena; W. D. Sansum, Cottage Hospital, Santa Barbara; E. M. MacKay, Scripps Metabolic Clinic, San Diego; H. E. Bellamy, University of California at Los Angeles.

Plans have been made to hold regular informal meetings at intervals until membership in the southern part of California is sufficient to warrant the organization of a separate branch in this region.

SCIENTIFIC NOTES AND NEWS

PROFESSOR ALBERT A. MICHELSON, who observed his seventy-seventh birthday on December 19, has resigned as head of the department of physics of the University of Chicago, his retirement to be effective at the end of the academic year. After a visit to Bermuda, Professor Michelson will resume his measurements of the velocity of light at Pasadena.

AN oil painting of Thomas A. Edison has been given to the Kansas State Agricultural College by the United Power and Light Corporation. The picture will be hung in the library of the engineering building.

THE *Pictorial Review* award of $5,000 for distinguished public service by a woman was presented to Dr. Florence Rena Sabin at a luncheon at Sherry's, New York City, on December 17. The speakers included Dr. Simon Flexner, director of the Rockefeller Institute for Medical Research; Dr. George E. Vincent, president of the Rockefeller Foundation, and Mrs. Donald Hooker.

DR. THEOBALD SMITH, of the Rockefeller Institute for Medical Research, was recently the guest of the New York State Association of Public Health Laboratories at Albany. He gave an address on "Clinical and Pathologic Significance of Races and Varieties among Pathogenic Bacteria."

HARBEN lecturers of the Royal Institute of Public Health have been appointed as follows: for 1930, Professor William H. Park, director, bureau of laboratories, Health Department, New York City, and for 1931, Dame Louise McIlroy, professor of obstetrics and gynecology, University of London, Royal Free Hospital. The council has made the Smith award for 1930 to Mr. H. R. Kenwood, emeritus professor of hygiene in the University of London.

DR. E. D. MERRILL, dean of the University of California College of Agriculture and director-elect of the New York Botanical Garden, has been appointed vice-president of the Fifth International Botanical Congress, which meets in Cambridge, England, during the third week of August. Dr. Merrill had previously been made vice-president of the section on taxonomy.

DR. CLARK WISSLER, curator of anthropology of the American Museum of Natural History and professor in the Yale Institute of Psychology, has been elected president of the New York Academy of Sciences to succeed Professor Charles P. Berkey, of the department of geology at Columbia University. Other officers elected are Horace N. Coryell, G. Kingsley Noble and Frederick W. Hodge, *vice-presidents;* Roy Waldo Miner, *recording secretary;* Horace W. Stunkard, *corresponding secretary;* George H. Sherwood, *treasurer,* and Herbert F. Schwarz, *editor.*

As a result of a mail ballot officers of the American Pharmaceutical Association have been elected as follows: *President,* H. C. Christensen, Chicago, Illinois; *First vice-president,* Walter D. Adams, Forney, Texas; *Second vice-president,* D. B. R. Johnson, Norman, Oklahoma; *Members of the Council* (for three years), H. V. Arny, New York, N. Y.; T. J. Bradley, Boston, Massachusetts; W. B. Day, Chicago, Illinois. These officers will be installed at the next annual meeting of the association in Baltimore, Maryland, to be held from May 5 to 10, 1930. The place of meeting for 1931 will be selected at Baltimore. The 1932 meeting will be held in Toronto, Canada, and will be a joint meeting with the Canadian Pharmaceutical Association.

OFFICERS of the American Pomological Society were elected at the recent Virginia meeting at Roanoke as follows: Dr. J. C. Blair, Urbana, Illinois, *president;* Dr. W. T. Macoun, Ottawa, and R. A. Van Meter, of the Massachusetts Agricultural College, *vice-presi-*

dents; W. R. Cole, Amherst, Massachusetts, *secretary,* and H. C. Miles, Milford, Connecticut, *treasurer.*

RAY M. HUDSON, assistant director of the Bureau of Standards, in charge of commercial standardization, has resigned. On January 2 he will become secretary of the Massachusetts division of the New England Council, with headquarters in Boston.

PROFESSOR L. R. SCHNEIDER, of the University of Michigan, is at the Geophysical Institute at Bergen analyzing the meteorological observations made during the American scientific expedition to Greenland last year and in 1927 under the leadership of Professor W. H. Hobbs.

DR. JOHN WHITRIDGE WILLIAMS, professor of obstetrics in the Johns Hopkins University School of Medicine, addressed the Rochester Academy of Medicine on December 4 on "Maternal Mortality."

DR. CLARENCE COOK LITTLE, managing director of the American Society for the Control of Cancer, gave an address on "Genetics and Cancer" at a "genetics luncheon" given by the American Institute, New York City, on December 7. The institute will give an "air and sunlight luncheon" January 18, at the Hotel Astor, at which Dr. Shirley W. Wynne will be chairman; Dr. William Crocker, director of the Boyce Thompson Institute for Plant Research, will speak on "City Air and Growth of Plants," and Edward R. Weidlein, director of the Mellon Institute of Industrial Research, will speak on "Studies of Air Pollution."

ON the afternoon of December 16, Dr. Jerome Alexander addressed the pre-medical group at Amherst College on "The Colloid Bridge Between Masses and Molecules." In the evening, he spoke to the Science Club on "Some Physico-chemical Aspects of Life, Mutation and Evolution."

DEAN BALDWIN M. WOODS, professor of aerodynamics in the University of California, recently gave three lectures at the University of Illinois, one popular in nature, entitled "What Next in Aviation?"; the other two technical, their subjects being "Precursors of the Airplane" and "Airplanes for Long Distance Flight."

DR. JAMES W. INCHES, formerly commissioner of health for the city of Detroit, delivered a lecture before the Royal Canadian Institute on December 7, entitled "An African Trip from Cairo to the Cape," which was illustrated by photographs of wild animals in both motion and still pictures.

DR. LEWIS DILLON ROBERTS, of the department of chemistry of the University of Southern California, has been appointed to head the list of twelve men who have recently been recommended for the testing of radio-active waters by the U. S. Bureau of Standards. Others included in the list are H. Schundt, of the University of Missouri; George B. Frankforter, of the school of chemistry of the University of Minnesota; E. E. Biefer, of the physics department of McGill University; Rolla R. Ramsey, of Indiana University; D. H. Kabakjian, of the University of Pennsylvania; H. N. McCoy, of Chicago, Illinois; S. C. Lind, of the University of Minnesota; Dr. Barker, of New York; A. F. Kovarik, of Yale University, and Charles F. Whittemore, of Chicago.

THE names of those who have been awarded research grants of the Virginia Academy of Science have been announced by Dr. R. E. Loving, professor of physics at the University of Richmond and chairman of the research committee of the academy. These grants are made annually and are awarded to scientific men in the state who have promising problems requiring financial aid. Those awarded grants were Dr. Donald W. Davis, professor of biology at the College of William and Mary; Dr. W. R. Cornthwaite, associate professor of chemistry at the University of Richmond; Dr. James E. Kindred, associate professor of histology at the University of Virginia; Dr. John C. Forbes, assistant professor of chemistry and director of biochemical research for the College Hospitals of the Medical College of Virginia; Dr. Leonard Albright, associate professor of physics at the University of Richmond, and Dr. J. A. Waddell, professor of pharmacology at the University of Virginia. These annual grants are given for the encouragement of scientific research in Virginia. The principal of the fund was given during Dr. J. Shelton Horsley's term as president of the academy by citizens of Virginia interested in the academy's work of furthering fundamental research in the state. Other members of the research committee of the academy besides Dr. Loving are Dr. J. Shelton Horsley, of St. Elizabeth's Hospital; Dr. Wm. A. Kepner, professor of biology at the University of Virginia; Dr. C. P. Olivier, professor of astronomy at the University of Pennsylvania, and Dr. Sidney S. Negus, professor of chemistry at the Medical College of Virginia. Dr. Garnett Ryland, of the University of Richmond, president of the academy, and Dr. E. C. L. Miller, of the Medical College of Virginia, secretary-treasurer, are *ex-officio* members.

THE Massachusetts Branch of the Eastern Association on Indian Affairs, Inc., of which Miss Mary Cabot Wheelwright is secretary, is cooperating with the association in a drive for funds with which to continue the public health education among the Indians of the southwest. The work is being carried

on with the full support of the Bureau of Indian Affairs in Washington. A benefit performance of Cochran's London revue, "Wake Up and Dream," will be given in New York on January 8, by the benefit committee of the Eastern Association on Indian Affairs. Miss Amelia E. White, of New York, is chairman of the committee. The officers of the association are: *President,* Dr. Herbert J. Spinden; *first vice-president,* Dr. Ellwood Hendrick; *second vice-president,* Mrs. Joseph Lindon Smith; *secretary,* Miss Amelia E. White; *treasurer,* Percy Jackson. The board of directors includes the following named Massachusetts members: Mrs. H. K. Estabrook, Dr. Frederick L. Hoffman, Warren K. Moorehead and Miss Mary Cabot Wheelwright.

AT the request of the secretary of commerce a study has been made by the Bureau of Efficiency of the examining divisions of the Patent Office to determine what action should be taken to bring the examination work up to date and to insure that future applications for patents will be disposed of expeditiously. At the time this survey was undertaken the work of patent examination was considerably in arrears, and the office was doing little more than disposing of a volume of business equivalent to current receipts of new applications. The bureau submitted a report recommending a reorganization of the Patent Office which, it is believed, will result in improved methods, in coordination of action on applications throughout the office and in a larger output of work of improved quality. Certain additional personnel was recommended to make the new organization and procedure effective.

THE chief recent acquisition by the department of geology of the British Museum is said by the London *Times* to be the Buckman collection of fossil Brachiopoda and ammonites. This numbers about 25,000 specimens, mostly brachiopods, and nearly all from the English Jurassic rocks. It is the bulk of the material collected by the late Professor James Buckman and his son, the late Sidney Savory Buckman. The former had unique opportunities for collecting, since he lived in the southwest of England when the early railways were being made, and this involved not only the opening of the railway cuttings, but also the quarrying of local stone for bridges, etc. His son studied and collected from the English Jurassic strata all his life. He acquired a specialist's knowledge of brachiopods and ammonites, and adduced theoretical considerations both in paleontology and stratigraphy. His collection is, therefore, regarded as of interest not only for its intrinsic value but also for enabling future workers to understand and test Mr. Buckman's work.

ACCORDING to *The Experiment Station Record,* an act of the last legislature has consolidated into a single board of nine members the governing authorities of the five higher educational institutions of the state of Oregon and the former board of higher curricula. The new board, which is known as the State Board of Higher Education, assumed control on July 1 and consists of the following: Herman Oliver, of Canyon City, for 1 year; A. R. Watzek, of Portland, for 2 years; F. E. Callister, of Albany, for 3 years; E. C. Pease, of The Dalles, for 4 years; Albert Burch, of Medford, for 5 years, and E. C. Sammons, C. L. Stair (chairman), B. F. Irvine and C. C. Colb, all of Portland, for 6 to 9 years, respectively. The appropriations and incomes for the several institutions for the current biennium are not to be disturbed other than by prorating among them the board's own expenses, but on July 1, 1931, the board is to inaugurate its own program. Full authority is given to reorganize the work of each institution to eliminate unnecessary duplication of equipment, courses, departments, schools, summer schools, extension activities, offices, laboratories and publications. In the interim the board is to make a complete survey of state-supported higher education in Oregon, using a special appropriation of $10,000 for the purpose. The various millage taxes for the different institutions are consolidated into a single state tax of 2.4 mills. A standardized system of accounts and records is to be prescribed by the board, and in the preparation of the budget the board is authorized to allocate all funds from all sources. It is instructed, however, to foster gifts to the separate institutions by faithfully devoting them to the institutions for which they are intended.

Nature states that the project of a tunnel under the Straits of Gibraltar to link the railways of Europe and Africa has reached the stage of preliminary investigations on the Spanish side. The scheme, in which the Spanish government is interested, was proposed by Lieutenant-Colonel P. Jevenois. It was recently expounded in an address ("El Tunel del Estrecho de Gibraltar") to the Real Sociedad Geográfica by Señor D. Rafael de Buen, of the Spanish Institute of Oceanography. The narrowest part of the straits is eight miles wide, but the depths there are great and the nature of the rock precludes the possibility of boring. The site that has been chosen lies some eleven miles west of Tarifa at the broader western end of the straits, where a preliminary shaft has been sunk. The proposed route follows a curve to the southwest in order to avoid the deeper channel of the narrows and terminates near Punta Altares in the Spanish Protectorate. A tunnel on that course would be a little more than twenty miles in length

and would dip at its lowest point to 1,500 feet below sea-level. From the preliminary shaft it is proposed to explore by means of sound waves the consistency of the rock. At the same time a detailed oceanographical exploration of the straits is to be undertaken.

UNIVERSITY AND EDUCATIONAL NOTES

BY the will of the late Colonel Henry Woodward Sackett, who died on December 9, eleven twelfths of the residuary estate, which is stated to be above $1,000,000, is left to Cornell University to be used in the beautification of the campus. In addition $250,000, of which $175,000 has already been used, is to be devoted to "the proper protection, development and maintenance" of the Fall Creek Gorge and Cascadilla Glen on the north and south borders of the campus.

THE will of the late Dr. John F. B. Weaver, Manchester, provides that the University of Maryland School of Medicine shall be the residuary legatee of his $150,000 estate, and that it will be used ultimately to establish a professorship, fellowship or research fund.

DARTMOUTH COLLEGE receives in trust $185,000 and is made residuary legatee under the will of the late R. Melville Cramer, M.D. The bequest reverts to the college after the death of the first beneficiaries and is to be known as "The R. Melville Cramer Foundation." The object of the foundation is to provide fellowships, especially in genetics or other laboratory investigations.

Two research fellowships have been endowed with $100,000 in the Hospital for Joint Diseases by Frederick Brown, who has been president of the hospital for six years. Under the terms of this gift the income of about $4,800 will be divided between two fellows chosen by the committee on award. They must be graduates of Grade A medical schools and have served internships in other hospitals.

PROFESSOR ARTHUR J. TIEJE, chairman of the department of geology at the University of Southern California, will have charge of classes in geology at Columbia University during the summer session of 1930.

DR. CHEVALIER JACKSON has resigned his professorships at Jefferson Medical College and University of Pennsylvania and his posts as head of the clinics which these institutions have named after him. The resignations become effective in June. Dr. Jackson intends to devote his time to development of a clinic at Samaritan Hospital and to his work as professor at Temple University School of Medicine. He will continue as William Potter Memorial lecturer at Jefferson.

DISCUSSION

THE POPULARIZATION OF SCIENCE

THE scientific progress of a country is dependent on the appreciation of science by an interested public as well as on the support and encouragement of wealthy men. Many of the greatest strides have been made, it is true, through the patronage of philanthropists. But a comprehensive, sound body of science can no more be built without the credence and sympathy and even the practical assistance of a large part of the population than could the Cathedral of Chartres have been erected, unaided, by the nobles of Beauce. The best science, like the greatest art, belongs to the people and must express their spirit.

In America we are witnessing to-day a nation-wide flowering of interest in science that is without precedent. A number of startling disclosures, such as radioactivity, the automobile, the aeroplane, the radio, the X-ray—all of them the results of scientific research—have forcibly impressed on every one the concrete significance of science to his own welfare. The scientist must nourish this new-born interest. The medium through which he must work to this end is primarily the press. The demand for scientific information exists; he does not have to create it. His responsibility and opportunity consist in providing accurate material in sufficient quantities and of proper quality.

In this country the literary popularization of science on a large scale is roughly coeval with the present century. Previously popular lectures were the favorite means. Among the names which shine brightest in both fields is that of Robert Kennedy Duncan (1868–1914), whose efforts to promote cooperation between science and industry found expression in the establishment of the industrial fellowship system. More lately the foremost figure has been Edwin E. Slosson, whose recent death was such a great loss to the scientific professions. Both men were remarkable for their power of translating technical achievements into simple, lucid, emphatic, correct language. The success of Slosson's Science Service is well known; this organization is now one of our chief

agencies for the popular dissemination of scientific facts.

The use of slang has been proposed by J. H. Collins[1] as a device, well in harmony with the tempo of the day, for calling attention to the results of scientific research. This suggestion is worthy of consideration; that we shall see it in operation can not be doubted, and, indeed, a trend in this direction can already be observed.

We can not but feel that Collins has taken a somewhat extreme stand in advocating the wholesale abandonment of the classics and of the standards of good English. Slang may well have its place in popularization, but by its very nature it is of only fleeting appeal. Even newspapers and magazines that make a fetish of the sensational do not go to marked lengths in the use of inelegant diction, except in their comic sections. The stylistic excellence of Collins' own writing, and of the two technical works he cites as examples of good composition illustrates the fact that, though his ideas might appear to be radical, he does not intend that he should be taken too literally. Science, a dignified branch of learning, must not be treated with a levity that would invite disrespect. The difficulty of imparting popular scientific knowledge lies in the obscure and monotonous literary style of the scientist and not in a demand for slangy literature.

The newspapers that use science articles are not inclined to overlook the great educational influence they exert. The editors of such papers do not shirk their duty as educators by using coarse expressions. "Rubber-stamp" writing and "journalese" are disappearing. Some of the most successful American papers are successful because they have remained steadfast in their high educational policies and have sought constantly to bring their readers up to the same level.

In discussing the composition of popular articles, let us first examine the purely technical paper, which serves as the foundation. This document, enigma though it may be to the uninitiated, in general possesses the very important quality of being logical in arrangement. The usual order of treatment—historical introduction, theoretical background, experimental part, discussion of results and conclusions—is symbolic of the scientific method and of the savant's habits of thinking. There are, however, a multiplicity of technical polysyllables, a stereotyped phraseology, a tendency toward errors in grammar and a circuitous method of expression. The last difficulty, possibly due to the innate conservatism of the scientist, has been referred to as the use of the alternating current instead of the direct in conveying the thought. As the article must be shortened considerably in translation into every-day English, these faults should be corrected during the process. The important point to be noted is that the arrangement of the subject-matter corresponds not only to good newspaper usage but also to good literary style.

Probably the most difficult part of popularization is the preparation of the summary "lead," the introductory paragraph that attracts the attention of the reader and arouses his interest by linking the subject-matter of the article with his personal experience. Whether or not this introduction answers all the questions of the "old time" news lead—who, what, where, when and why—it should always sound the keynote of the information to be conveyed. Unfortunately, in the hands of those untrained in science, this introduction is likely to be poorly chosen, and to emphasize some point that is merely speculative or at best of minor importance. This probability has led to an unreasonable dread of all gentlemen of the press by many scientific men. Aggravation of this fear is caused by the general newspaper practice of having headlines composed by men other than the writers of the copy; a worthy article, conservative and accurate, may have its effect ruined by a too enthusiastic headline writer. On the other hand, the scientist, inexperienced in popular psychology, is inclined to choose a lead uninteresting to the reading public. E. E. Free and Morris Fishbein, happy combinations of scientist and popular writer, never seem to have difficulty in finding good leads.

Before leaving the discussion of the introduction we wish to add that the lead is often written first. Its preparation should always be deferred, however, until after the remainder of the article is ready—a practice that will result in economy in time and in a more interesting introduction. Still another advantage of this procedure, at least from the scientist's point of view, lies in the fact that the writer will then base his lead upon the facts instead of shaping the facts to fit his lead.

The writing of the body of the translation is not difficult to the competent. As we have already said, the arrangement of the original technical paper is usually logical, and the experienced writer chooses his material from the various sections in the order in which they occur. From time to time he stresses the reader's interest by tying to his statements references to matters of common experience.

A knowledge of grammar may well be assumed for the popularizer, but it is equally important for the scientific man, particularly if he aspires to become a non-technical writer. How many important discoveries have been overlooked by journalists because they were described originally in ambiguous and unemphatic language! Sometimes this defect is over-

[1] *Chem. Met. Eng.*, 36: 619, 1929.

come through the efforts of another writer who "interprets"—by rewriting in more understandable form, that is, in more straightforward English—his predecessor's work.

Rhetoric, or artistic discourse, plays a vital rôle in reconstructing technical papers. How else can the heavy style of the scientist be translated into forceful, gracious prose if not through the application of the principles of composition? Unfortunately the scientist rarely realizes that there are rhetorical methods for securing force, rapidity, emphasis, life and the other desirable qualities of good writing. It may even be that more practiced writers also are somewhat ignorant on this subject.

Wide reading of the classics and of the best modern writing is a necessary supplement to a study of grammar and rhetoric. From such reading the budding writer derives not only a feeling for the best in literary style, but also the knowledge of human nature essential to a broad discussion of contemporary events and trends. He is then able to integrate in his compositions the experience of centuries of history. The benefits of extensive reading are apparent in the works of the masters of scientific literature, some of whose writings deserve high rank among the classics of all time.

A good translation of a scientific paper is a work of art. It is at once elevated and popular; it manifests to all that which is recondite. Science describes her accomplishments abstractly in technical language. Art reveals these facts, not aridly, but concretely, addressing itself not only to the understanding, but still more to the sentiments of the ordinary man. Like every artist, every man who writes successfully must catch the spirit of the ensemble before him. He must therefore have interested perception and enthusiasm for things scientific.

The treatment accorded scientific progress in magazine articles is generally measured and dignified, but newspaper technique is occasionally open to question. We do not mean to disparage in any way the ability and sincerity of the news reporter, but we believe it sometimes happens that his actuating enthusiasm in his object—the emphasis of the sensational and novel—leads him to exaggerate and even wrest partly out of shape, although without real intent, the main facts of technical discoveries. On the other hand, the editorial writer, skilled in sublimating news, adept at crystallizing events, has developed traits that peculiarly qualify him for the popularization of science. The broad field that he may cover, the greater time that he can devote to writing and the disinterested point of view from which he writes all tend to result in articles of accuracy, dignity and authority that are gratifying to the scientist. The feature or special writer, who is in some respects comparable with the editorial writer, may be equally successful as a popularizer of science. Finally, the usual excellence of syndicated articles should not be overlooked; the time assigned for the preparation of such material generally makes it possible for the author to obtain the constructive criticism of the scientist whose work is discussed.

A happy condition seldom realized is the literary collaboration between writer and man of science. Every newspaper interested in scientific news should have reliable sources of information who may be consulted for authoritative criticism. The statement is often made that any good writer can make of a technical paper an excellent popular article. This mistaken conception ignores the obscurity often found in scientific writing and the nice balance required by different phases of the subject. An unhappy juxtaposition of ideas, an unthinking distribution of emphasis, can do much to void the accuracy of the translation. Even the popular writer with a broad knowledge of science will not regret submitting to the judgment of the technical specialist.

William A. Hamor,
Lawrence W. Bass

Mellon Institute of
Industrial Research

THE ZODIACAL LIGHT

One of the problems undertaken by the Harvard Eclipse Expedition to Malaya last May was that of the photography of the zodiacal light in connection with the photography of the corona. By standardized measures of the photometric brightness it was hoped to test for a possible connection between the illumination of the outer corona and that of the zodiacal glow.

On account of clouds in the western skies every evening while at our station it was impossible to obtain the zodiacal light photographs anticipated.

Visual observations of the zodiacal light were made, however, on shipboard while crossing the Indian Ocean. These revealed so surely a fluctuation in its brightness over a period of two or three minutes that some publication of the observation seems important. These fluctuations were corroborated by my colleague, Mr. Weld Arnold, and we checked satisfactorily the extent of its visibility from time to time by comparison with neighboring stars.

The recent issues of *Popular Astronomy* contain references to a similar observation by Chaplain George Jones, U. S. N., in 1854, and by other observers at various times, appearing to confirm the reality of the phenomenon. The rapidity of the fluctuation that we observed in 1929 suggests that we

may be dealing with an atmospheric or gaseous affair excited by solar activity. Perhaps it is not without significance that the fluctuations observed this year are concomitant with solar activity, as indeed is the general appearance of the corona itself.

It is to be hoped that the publication of other possibly existing observations may add materially to the solution of the problem. It seems that we have in the zodiacal light a somewhat neglected field of unusual cosmic interest.

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CRANBERRY FALSE-BLOSSOM DISEASE SPREAD BY A LEAFHOPPER

OBSERVATIONS and field experiments made during the summers of 1924, 1925 and 1926 brought evidence that the false-blossom disease of cranberries is spread by the leafhopper *Euscelis striatulus* Fallen.[1] Carefully controlled experiments carried out during the past three summers have confirmed the results of my earlier work and prove the ability of this insect to transmit the virus of false-blossom.

Cranberry seedlings were grown in a greenhouse kept free from insects by fumigation. Such seedlings have never shown any of the symptoms of false-blossom disease unless purposely exposed to *Euscelis striatulus*. Cultures of this leafhopper obtained from bogs in Massachusetts, Long Island and New Jersey were allowed to feed for various periods of time on diseased cranberry plants held in insect-proof cages. The leafhoppers were then transferred to healthy seedlings on which they were allowed to feed for about two weeks. Numerous seedlings so exposed have taken the false-blossom disease, while check seedlings of the same age and grown under the same conditions but kept free from insects have remained healthy. Under favorable conditions the plants show the first symptoms of false-blossom about one month after being exposed to virus-bearing leafhoppers. The disease is recognized in its early stages by small leaves, by an upright habit of growth and by the production of an abnormally large number of secondary shoots. One plant to which false-blossom was experimentally transmitted produced two typical false-blossom flowers. It is not known whether *Euscelis striatulus* is the only insect that spreads false-blossom, but several other cranberry insects that were tested failed to transmit the virus of this disease.

IRENE D. DOBROSCKY
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[1] I. D. Dobroscky, "Insect Studies in Relation to Cranberry False-blossom Disease." Proc. 58th Ann. Meet. Amer. Cranberry Growers' Assoc., pp. 6–11, 1928.

CELL FUSIONS IN FUNGOUS HYPHAE

THAT fusions between fungous cells have other interests than those associated with sex is shown in the vegetative mycelium of the common mushroom, *Psalliota campestris*. Cytological studies recently made on the mycelium have revealed the existence of numerous end-to-end as well as lateral fusions between adjoining hyphal cells. The walls between many of the hyphae of the developing strand begin to dissolve away at very early stages and the process is continuous to maturity. The mature strand consists for the most part of very large cells in the core region. Most of these are from five to six times the diameter of the original hyphal cells and about five times or more as long. The anastomoses as stated above begin very early, sometimes shortly after the hyphae emerge from the germ vesicle, and in some cases even the vesicles have been observed to fuse. The large cells of the strand have developed from the fusion of two or more hyphae of smaller diameters and may be looked upon as a composite formed by the fusion of smaller hyphae. The cells so formed serve without doubt in a vascular capacity and are perhaps an adaptive response for the conduction of food materials to the rapidly growing carpophore. The large capacity of many of the cells suggests also the possibility that they function as reservoirs for the storage of food materials to be supplied to the carpophores during their period of rapid growth. These studies will be reported in full in a forthcoming number of the *American Journal of Botany*.

ILLO HEIN

INFORMATION CONCERNING CASTOROIDES

THE very recent discovery of a beautiful skull of *Castoroides ohioensis* Foster, the giant Pleistocene beaver, in Illinois has started the writer on an intensive study of the osteology of this interesting species. At the present time I am most anxious to ascertain the present location of any and all specimens or fragments of this species for use in a forthcoming paper. Search of the literature has yielded forty-two records of this form, but in only fifteen cases do I know where the specimens are at present deposited. For example, where is the perfect Clyde skull, and the fine skull found at Charleston, Illinois, and reported by Leidy in 1867? The undersigned would greatly appreciate it if the various colleges, museums and private collectors would mail him a list of what they have of *C. ohioensis*, together with data on where the material was found and the present catalogue number of the specimens. Full credit will be given for all information.

A. R. CAHN
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SCIENTIFIC BOOKS

Introduction to Contemporary Civilization; an Orientation Course for College Students. By WALTER LIBBY. pp. xiii, xix + 272 pp. New York and London, A. A. Knopf.

CHARLES BEARD says that the history of civilization if intelligently conceived may be an instrument of civilization. The book which is before us for review attempts to amplify this statement of Beard's. The book is called "Introduction to Contemporary Civilization" with a sub-title, "An Orientation Course for College Students," and is the first of its kind and therefore a pioneer in a new field of education.

In his preface the author says:

> After having presented the materials of this orientation course to a class of some six hundred freshmen at an institution of higher learning in the United States as well as to a more select group of students in one of the Canadian universities, I am convinced that, through an educational experience roughly comparable to that of a mountain climber, the aspiring youth of the twentieth century (when mechanical devices are doing so much to overcome the obstacles of space and time) should be enabled to transcend the limitations of their special studies and to reach a point of vantage from which to survey, not merely one phase of contemporary life, but a wide range of its interrelated phases. I have, therefore, written this work for college students to give them a synopsis or bird's-eye view of present conditions, to help them find their bearings in the diversified studies of the academic curriculum, to provoke their cooperation in the educational process, and to introduce them to the responsibilities of our complex social life.

Dr. Walter Libby, the author of this timely book, has been a lifelong student of the historical background of modern science and is therefore eminently qualified to present the subject of contemporary civilization, as his experience dictates.

This task of orientating the student is one which colleges and universities have set themselves only recently. Many students come to the universities with their minds clearly made up as to what they wish to prepare for, but have their views considerably modified in the course of a year or so when they discover that they are unable to adapt themselves to the work they have planned to take up as a life profession or that they are more interested in doing something else. Others go to college with the frank statement that they do not know exactly what they wish or to what career they are most suited. It is for the purpose of helping both types of students that orientation lectures are now being given in many of our larger educational institutions. Unlike European systems of education which as a rule offer a very limited field of opportunity to prepare for a life work, our American universities offer such a variety of possibilities that it is a difficult problem to orientate the student according to his abilities and aspiration. An orientation course, to serve a practical purpose, must omit extreme specialization on the one side and too great an overspreading on the other.

Dr. Libby's book is composed of a series of thirty chapters with different subject headings, all treated, however, with the synthetic philosophy with which Dr. Libby surveys the accomplishments of our civilization. Each chapter, to the reviewer, seems too short for a formal history of the particular subject treated, yet each is concisely and forcibly set forth, written with much thought, and is in reality a historical essay. And should one care to carry the investigation further, the extensive and authoritative references at the end of each chapter will assist in the task of amplification. The references in themselves make a valuable bibliography on contemporary thought and in the public or university library are accepted as standard titles on history and culture.

A study of the chapters reveals an immense amount of erudition. The first chapter treats of the idea of concept of progress and shows that civilization and culture develop gradually with the slow growth of human knowledge. The following chapter, "The Development and Occupation," tells how women became the first inventors by necessity. Chapter three relates to the selection of plants and animals and emphasizes the great basic occupation of agriculture (raising of crops and rearing of live stock). The remaining chapters discuss social, economic, educational and international moral problems. The vast subject of scientific progress and the development of scientific associations, as well as technology, is treated critically and in a commendable manner. The author shows that the subjects of fine art, modern drama and religion have an integral part in our human culture. Probably the most practical and suggestive chapters are the two having to do with the psychology of research. Here Dr. Libby shows his mastery of psychology. Scientific students would do well to examine these chapters critically with a view to profiting by the lessons of psychology. A study of the minds of scientific men and their method of arriving at results, expected and unexpected, constitutes one of the interesting phases and romances of the history of science. What are the mental processes involved in scientific discovery? Are they those of creative visual imagination or of stimulation by sympathetic cooperation? At any rate, there is certainly one thing to be understood—a scientist is born and not made.

To the reviewer, the last chapter was of particular interest. Many systems of classification of the

sciences have been set forth, based more or less upon a philosophical concept of the theory of knowledge. The attempt here is to define knowledge in two broad categories—theoretical and practical. Space does not permit a critical discussion of this study of the science of sciences, important as it is from the standpoints of the methodology and history of science.

Dr. Libby evidently recognizes the fact that a good index greatly increases the practical efficiency of a text-book, for his book contains a much larger analytical index than is usually found in books of this size, and its content is as carefully worked out as that of the rest of the volume.

Dr. Libby's book will be also a most inspiring and useful one in the field of adult education and a good guide and source book for purposes of self-education. Therefore college students, laymen and librarians will do well to keep this volume on their shelves.

FREDERICK E. BRASCH
LIBRARY OF CONGRESS

SCIENTIFIC APPARATUS AND LABORATORY METHODS

PRESERVING CERTAIN GREEN ALGAE IN NATURAL COLORS

PERMANENT slide mounts of the green alga Chara made as described below were very instructive. The natural colors of orange, brown and green were preserved as well as a fine sharpness of detail. The preservation of the sexual organs and thallus was better than in material preserved by usual methods. Two species of Chara were used, both heavily encrusted with lime.

The process is a modification of a method published in 1897[1] and in 1921[2] by Dr. A. F. Woods. Deviations from the schedule might be made to suit different materials. Preparations made as described were not injured by long exposure to the brightest sunlight. Thirty per cent. nitric acid did not change the colors for a remarkably long time.

Copper is employed to fix the chlorophyll, forming a light-fast compound very similar in color and shading to natural chlorophyll. Acetic acid removes the lime. A salt of copper is mixed with the acid so that the two processes go on simultaneously. Of several schedules the following was most successful for lime-encrusted Chara.

(1) Soak plants in cool tap water two days to partly remove lime.

(2) Remove air by soaking in cool boiled water or in an aspirator.

(3) Fix about four hours in a solution containing 4 per cent. acetic acid and ½ per cent. C. P. copper acetate (sulphate may be used). Use 50 volumes of solution to one of material. Agitate material occasionally to remove CO_2 bubbles.

(4) Pour off the blue solution and add to it just enough concentrated ammonia to give it a marked purple tint. The purple is due to the formation of complex copper-ammonia ions. Pour the basic solution back on the material and let stand for an hour or until the thallus shows a marked blue-green color.

(5) Wash in tap-water ten minutes. Soak in 50 volumes distilled water for five minutes. Material should now show thallus bluish green, antheridia orange and oogonia brown and green. Transfer to a 5 per cent. glycerine solution in distilled water. If 5 per cent. glycerine causes plasmolysis omit wash in tap water using 5 per cent. glycerine instead.

(6) In order to preserve the orange and brown pigments the following schedule must be rigorously observed. Pieces of smooth glass should be cleaned and the material placed on them in lots of the size desired in the permanent glycerine jelly mounts. Cover each bunch of material with thin glasses. Start artificial evaporation at once. If available use hot sunlight and air. The following was used with success. Slides were placed on an asbestos board and heat projected upon them from a regular electric heater. Adjust so water evaporates steadily but not suddenly from under the cover-glasses; add 5 per cent. or 10 per cent. glycerine as needed. Toward the end more concentrated solutions may be used to advantage. Occasional examination should be made to guard against plasmolysis or swelling. Practice is necessary. Not more than ten or twelve hours should be employed in evaporation if the orange and brown are to be preserved.

(7) When nearly the consistency of pure glycerine, remove the glasses and mount on clean new slides in Kaiser's gelatin. Allow to harden for at least a week before sealing two or three times with balsam. The formula for Kaiser's gelatin may be obtained from Lee's "Microtomist's Vade-Mecum" or other text of histology.

The method outlined above is difficult but it is possible to make some beautiful preparations. It is a modification of an old process employing well-known principles. Such a procedure has been applied to plants other than the algae with success.

UNIVERSITY OF MARYLAND MARK WINTON WOODS
OCTOBER 25, 1929.

[1] A. F. Woods, "Method of Preserving the Green Color of Plants for Exhibition Purposes," *Bot. Gaz.*, 24: 206, 1897.

[2] A. F. Woods, "Preserving the Green Color of Algae, Protonema, etc.," *Quar. Jour. Mic. Science*, 14: 225–228, 1921.

SPECIAL ARTICLES

ANCIENT MIGRATION ROUTES OF CENTRAL ASIA[1]

The discovery by Andrews, Granger, Berkey and Borissiak of a central Asiatic vertebrate fauna from Upper Jurassic to Pleistocene time and onwards, between 40° and 50° N. Lat. and 60° and 120° E. Long., throws a new and important light on the world centers of origin and the routes of migration both of Reptilia and Mammalia. In Upper Jurassic and Lower Cretaceous times a Sauropoda center is revealed of several hundred miles east and west, between the 40th and 50th parallels. From this center (Chart I, 1) it appears probable that the giant sauropods migrated to every continent, including Australia, where they are recently reported in Queensland, to East Africa and the island of Madagascar (1–6). At three points the Mesozoic Mammalia occur in the same beds with the Sauropoda and it is possible that they followed routes 2, 3 and 6; also that the pro-Marsupialia may have entered Australia along route 5 in Lower Cretaceous time. After a 60,000,000-year interval the Mesozoic Mammalia gave rise to the giant mammals known as Proboscidea, including both mastodonts and elephants. Between Eocene and Pleistocene time the Proboscidea, originating in Africa (Chart II, 6), spread northward and eastward across the Jurassic Sauropoda center and reached every continent except Australia, so that in several regions their giant fossil remains are now found not far distant from the Lower Cretaceous beds in which occur the remains of the far more ancient sauropods. Originating in Africa in the Lower Eocene, the Proboscidea reached Europe, central Asia and India in the Lower Miocene, North America in the Middle Miocene and South America in the Upper Pliocene and early Pleistocene; no less than four distinct lines of proboscideans entered South America, including three mastodonts—the Andean and the Humboldtian, also the *Stegomastodon* from India—besides one true elephant which penetrated into French Guiana. A further point of interest is that in Pliocene and early Pleistocene times the Proboscidea were accompanied on at least three of their migration routes by primitive man. At two points remains of primitive Upper Pliocene man have been discovered with Upper Pliocene elephants. In the recently discovered central Asiatic center (7 A, B, C) a striking feature is the *absence* of the horses; up to Miocene time not a single equine has been discovered. This proves that there is a very important still to be explored area (8) north of the 50th parallel which, if it yields Tertiary horizons, will probably reveal the original adaptive radiation center not only of the horses but of the tapirs, rhinoceroses and titanotheres as well, because these small ancestral quadrupeds successively appear by *invasion* in the chief North American center (3), also on the 40th parallel;

[1] Abstract of paper read before the National Academy of Sciences, Princeton, November, 1929.

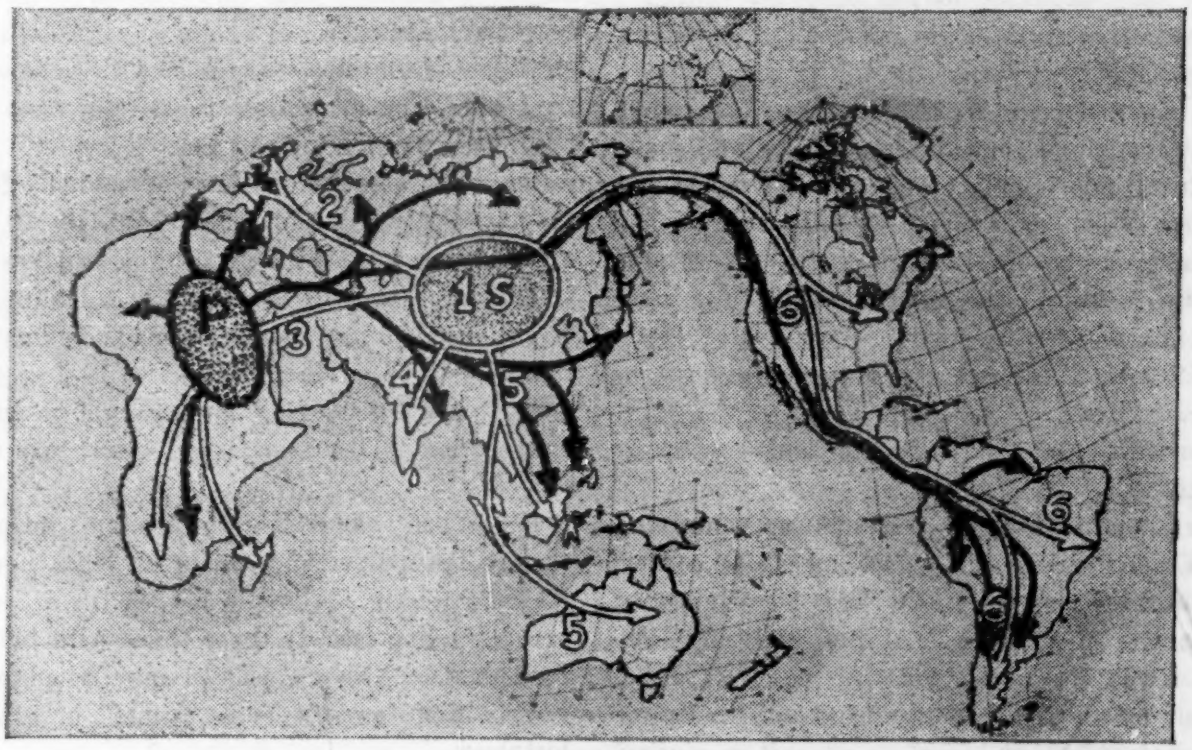

Chart I. MIGRATION LINES OF SAUROPODA (MESOZOIC), OF PROBOSCIDEA (CENOZOIC)

(1 S) Recently discovered (Andrews, Borissiak) central Asiatic origin of the Sauropoda in Lower Cretaceous time. Migration lines (double): (2) To western Europe, (3) to Africa and Madagascar, (4) to India, (5) to Australia, (6) to North America and South America.

(P) Cenozoic center, origin of the Proboscidea. Migration lines (solid) reversing in direction those of the Sauropoda: Africa to western Eurasia, India, Japan, the East Indies, North America and South America.

There is evidence that in Upper Pliocene and Lower Pleistocene times man may have followed the same migration route in India, western Europe, and south Africa, as the Upper Pliocene proboscideans.

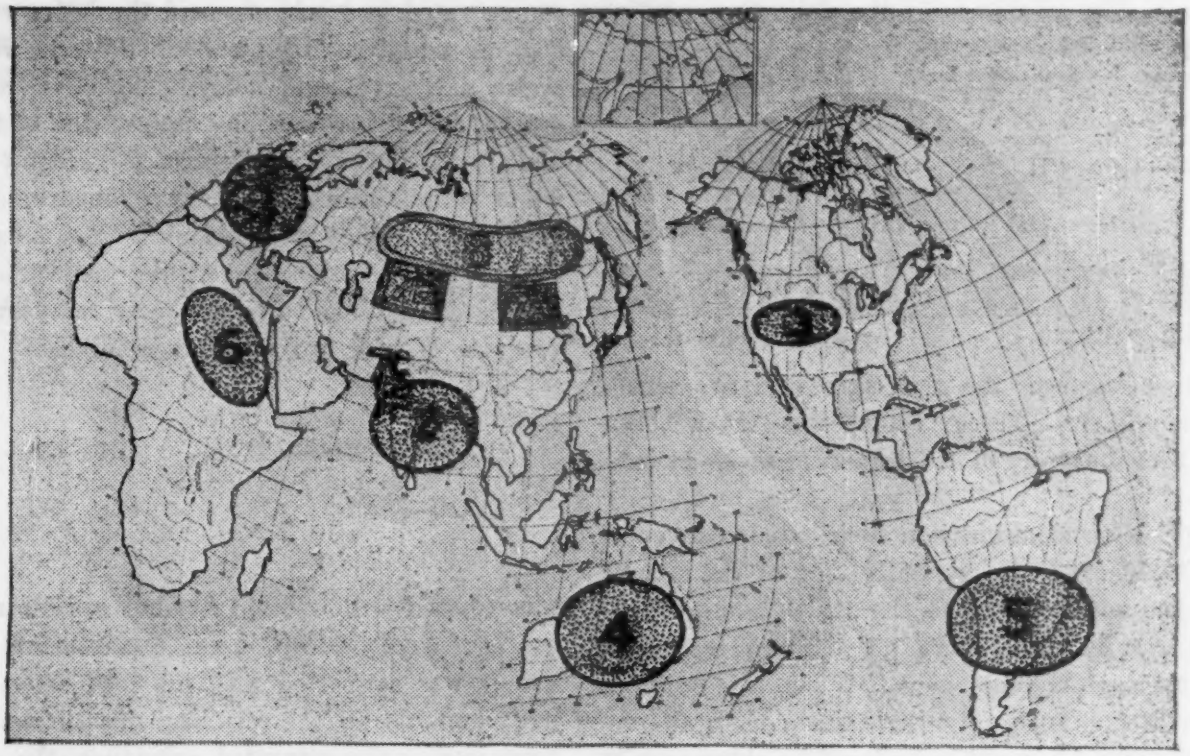

Chart II. WORLD CENTERS OF MAMMALIAN ORIGIN IN ORDER OF DISCOVERY

(1) Western Europe—Cuvier. (2) India and Burma—Falconer and Cautley. (3) Western America—Leidy, Marsh, and Cope. (4) Australia—Owen. (5) South America—Ameghino and Scott. (6) North Africa—C. W. Andrews and Osborn.

(7 A) East central Asiatic area—Roy C. Andrews (1922–1929). (7 B) West central Asiatic area—Borissiak. (7 C) Baluchistan area—Forster Cooper. (8) Unexplored north central Asiatic area, in which will probably be found the plains and uplands ancestors of the tapirs, horses, titanotheres, rhinoceroses. The chief adaptive radiation center of the odd-toed ungulates or Perissodactyla.

moreover the central Asiatic fauna (7 A, B, C) seems to point to a series of invasions from the north. During the early Tertiary, at least up to the close of Oligocene time, this center (7 A, B, C) was in close connection by migration with the North American center (3), and in Oligocene time it formed a close connection with the west European center (1). Another very striking feature of the central Asiatic center (7 A, B, C) is the absence of any trace of the Proboscidea until Miocene time, a fact which serves to establish north Africa (6) as the probable center of adaptive radiation of the Proboscidea, because all the primitive members both of the mastodontine and elephantine divisions have now been discovered in Africa. Accordingly from central Asia (7 A, B, C) and from north Africa (6) it now appears probable that India (2) was populated chiefly by heat-loving mastodonts and elephants and by offshoots of the great bovines and antelopines of Africa, because the adaptive radiation of these animals now seems to have had its center in the upland plateaus of that continent (6). Returning to the central Asiatic region (7 A, B, C), the mammalian fauna was not only extremely varied in Eocene and Upper Oligocene times but extremely flourishing, all the genera and species being represented by animals of relatively stupendous size. Aside from the absence of the horses and of other ancestral perissodactyls, it is important to note the absence as well of all trace of the Palaeotheres, the discovery of which by Cuvier in (1) aroused such excitement, and also of the ancestors of the great bovine family. This central Asiatic fauna, discovered by Andrews, Granger, Berkey and Borissiak, is accordingly highly characteristic of the Northern Hemisphere—it is the ancient Holarctic or North Hemispheral fauna of the world.

HENRY FAIRFIELD OSBORN
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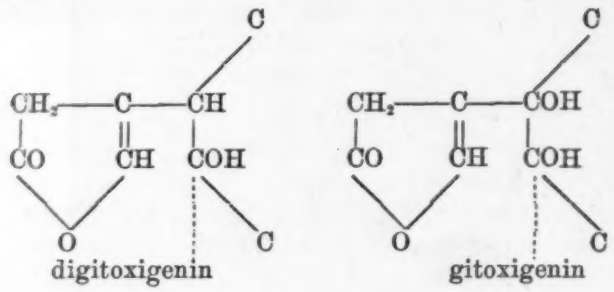
THE STRUCTURAL CORRELATION OF GITOXIGENIN WITH DIGITOXIGENIN

IT has been the assumption that digitoxigenin and gitoxigenin, the two aglucones found in the principal cardiac glucosides of the digitalis plant, are structurally very closely related. Recent work from our laboratory as well as from that of Windaus and coworkers has brought partial confirmation of this assumption. However, to what extent the structural analogy between these substances may be developed remained to be determined. The solution of this question, which is of great importance in the problem of the structural chemistry of the digitalis glucosides, has now been practically completed. Our recent investigations, which will be published more fully elsewhere, have conclusively shown that gitoxigenin is hydroxydigitoxigenin. The hydroxyl group which is presumably of tertiary character is situated probably on a carbon atom adjoining the one which bears the other tertiary hydroxyl of digitoxigenin and which is involved in the isomerization to iso compounds.

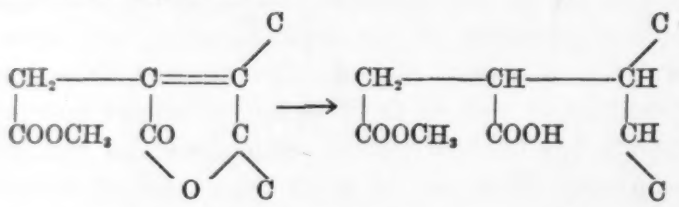
This relationship is shown in the following partial formulas:



In all other respects the two aglucones are structurally identical. These conclusions have been reached from the study of the following series of substances.

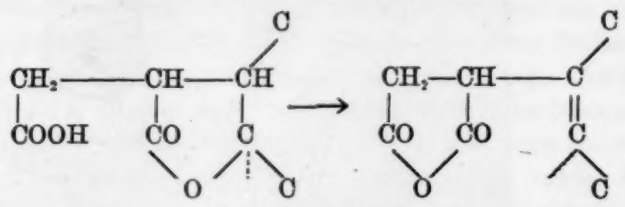
Gitoxigenin on isomerization by alkali is converted into isogitoxigenin.[1] On saponification of the lactone group of the latter substance, the salt of isogitoxigeninic acid results, which can be oxidized by hypobromite to isogitoxigenic acid. When the latter is treated with concentrated hydrochloric acid, the remaining tertiary hydroxyl is replaced by chlorine with the formation of chloroisogitoxigenic acid. Simultaneously stereo-isomerization occurs under the influence of the reagent on some center of asymmetry in the molecule. The chlorine atom in this acid can be removed under certain conditions as hydrochloric acid with the production of anhydro isogitoxigenic acid.

It was hoped that on catalytic hydrogenation this anhydroacid (as the ester) would absorb one mol of hydrogen with the formation of a substance identical, or at least isomeric, with the previously described isodigitoxigenic acid obtained from isodigitoxigenin. The reaction, however, took an abnormal course in that two mols of hydrogen were consumed. Investigation showed that not only was the double bond hydrogenated but the lactone group was cleaved with the formation of a saturated acid in accordance with the following scheme:



On saponification this half ester readily yielded the dibasic acid.

Following a number of unsuccessful attempts the identical dibasic acid was obtained also from digitoxigenin through the following steps. Isodigitoxigenin[2] after saponification was oxidized by hypobromite to isodigitoxigenic acid. On treatment with concentrated hydrochloric acid the latter was isomerized to γ-isodigitoxigenic acid. When treated with acetic anhydride and acetyl chloride a reaction occurred, which involved cleavage of the lactone group and formation of a substituted succinic anhydride while simultaneously the newly uncovered hydroxyl group was removed as water.[3] The secondary hydroxyl group elsewhere in the molecule was also acetylated. When this anhydro anhydride acetate (acetate of anhydro-γ-digitoxenoldiacid)



was treated with methyl alcohol containing one per cent. of hydrochloric acid, the succinic anhydride group was converted into the half ester. Catalytic hydrogenation of the resulting unsaturated half ester gave rise to the saturated substance, the acetate and half ester of γ-digitoxanoldiacid. On saponification γ-digitoxanoldiacid was produced and this substance proved to be identical with the above described dibasic acid obtained from gitoxigenin. This conclusion was substantiated by the comparison of the neutral dimethyl esters prepared from both acids as well as of the stable half esters which resulted on partial saponification of the latter.

WALTER A. JACOBS
EDWIN L. GUSTUS

THE ROCKEFELLER INSTITUTE
FOR MEDICAL RESEARCH

[1] W. A. Jacobs and E. L. Gustus, *J. Biol. Chem.*, 1928, 79: 553; 1929, 82: 403.

[2] W. A. Jacobs and E. L. Gustus, *J. Biol. Chem.*, 1928, 78: 573.

[3] W. A. Jacobs and E. L. Gustus, *J. Biol. Chem.*, 1929, 84: 183.

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SCIENCE NEWS

Science Service, Washington, D. C.

ARCTIC FLIGHT OF THE "GRAF ZEPPELIN"

SOUNDINGS of the water below and of the air above, with automatic radio-equipped balloons, will be part of the program of scientific observations to be made by the *Graf Zeppelin* when it flies over the North Polar regions next spring. The flight is to be made under the auspices of the International Society for Arctic Research by Aircraft, generally known as Aeroarctic.

Dr. Walter Bleistein, treasurer of Aeroarctic and secretary of its technical commission, has left Washington, D. C., to return to Germany. While in the United States he organized American cooperation. Dr. J. A. Fleming, acting director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, is secretary of the American section of the society.

The first ocean soundings from a dirigible will be made as the *Graf* sails over open lanes in the ice, Dr. Bleistein told *Science Service*. This will be done with the sonic depth finder, which measures the time taken for a sound to reach the bottom of the ocean and be reflected back to a microphone that is part of the apparatus. The airship will not alight, but will lower the instruments on the end of a cable to the water surface. Electrical connections between the float carrying them and the airship will reveal the water depth at any point. While the soundings are being made the *Zeppelin* will be navigated to follow the lane.

Aerial study will be made by sending up small balloons, equipped with instruments for measuring atmospheric pressure, temperature and humidity. When such balloons are sent up from places in populated regions, the instruments are made to record the data. Usually they are found and returned to their source. As the Eskimos can not be depended on to return the balloons, this method can not be used, so the balloons will be equipped with small radio transmitters. They will automatically radio their observations back to the airship.

According to present plans, the expedition will start on April 1, from Tromsö, Norway, the European base, and is expected to take six weeks. After a preliminary flight to Spitsbergen, to acquaint the scientific staff with life on an airship, the first long flight will be made, skirting Spitsbergen on the southwest, across the Arctic Ocean between Greenland and the Pole to Beaufort Sea, thence across Alaska to Fairbanks, where a mooring mast and full equipment for handling an airship will be ready. A mooring mast is also provided at Tromsö.

The next flight will be over the great unexplored area between Alaska and the Pole; from Fairbanks northwest, across Wrangell Island, then north to within 200 miles of the Pole and back to Alaska, paralleling part of the first flight. The third flight will be to return to Tromsö by way of Northern Land and Franz Josef Land. As Northern Land represents a large unexplored area, the ship will cruise around over it. If feasible, a party will be landed, with sledges and equipment, and left to return to civilization over the ice.

In addition to the upper air observations and the oceanographic research, investigations will be made on the electricity of the atmosphere, on the magnetism of the earth and in meteorology.

Dr. Fridtjof Nansen, veteran Arctic explorer, will be the head of the expedition, while Dr. Harald U. Sverdrup will be second. Captain E. A. Lehmann, who took the *Graf Zeppelin* back to Germany after its last visit to America, will command the ship. The scientific staff will number twelve, while a crew of thirty-five will be carried. As in former trips, the engines of the ship will burn gas, a supply of which is being provided at Tromsö and Fairbanks. This gas consists largely of ethane and propane, two compounds of hydrogen and carbon.

The expedition is really a reconnaissance one, Dr. Bleistein emphasized. It will determine the feasibility of exploration by airship, and of landing parties on the ice. Should it prove successful, it will doubtless be the forerunner of future Arctic flights, on still larger airships, thus exploring thoroughly all the Arctic regions in a far more complete manner than is possible on the ground.

THE FATE OF PLANETS

THE rings of Saturn, now unique in the heavens, as far as astronomers know, may be rivalled by a similar system around the earth in the dimly remote future, Dr. Harlow Shapley, director of the Harvard College Observatory, said in a recent lecture. He spoke on "Planets and their Fate," as the third in a series of lectures at the College of the City of New York, on "Flights from Chaos."

"For some years we have been familiar with the fact that the earth's rotation is slowing down, that the day is lengthening, and that the moon is receding," said Dr. Shapley. "We have learned that after an interval of some fifty thousand million years the month and the day will be the same length again, as they were at the time the earth-moon system was formed. This equality of month and day in the future will be forty-seven of our days in length; at the time of the origin of the moon from the earth it was less than five of our present hours in length.

"According to calculation, the moon will ultimately return to the earth, and in the dimly remote future its fate will be disruption by the tidal forces of the earth and transformation into a ring system of myriads of moons such as that now observed around Saturn. This process may fail of completion if in the meanwhile the sun's stores of energy have become exhausted and our oceans have become frozen, stilling the tides which are involved in the machinery of the evolution of days and months. The irregularities are probably due to pulsations of unknown origin in the earth's crust. Though so close to us, compared with the stars, and though such a vast number of observations have been made of them, the planets and moons associated with the earth in the sun's family present some of the most baffling astronom-

ical mysteries. No theory of the origin of the planets is wholly satisfactory, though the current tidal evolution hypothesis, which has developed from the planetesimal hypothesis, accounts for the major features of the system.''

What is the origin of the asteroids, the tiny planets that swarm between the orbits of Jupiter and Mars? Whence came the several thousand comets that are members of the solar system? What caused the moons of Mars? How are astronomers to account for the observed speeds of rotation and revolution of the planets and the sun? These are some of the problems that Dr. Shapley pointed out, and of them, he said, the last one is ''perhaps most disturbing of all.''

''To account,'' he continued, ''for the observed rotation of the sun, Dr. Jeffreys, of England, has recently proposed the theory that the planets were formed not through the tidal disruption of the sun by the near approach of another star, but by the actual glancing collision of our sun with another star. The shearing forces of such a collision could account for the rapid rotation.

''The near approach of two stars is an exceedingly rare phenomenon. It is calculated to occur in our galactic system not oftener than once in a thousand million years. The actual collision of two stars would be a much more uncommon occurrence. Even so, since the astronomer measures time in terms of ten millions of millions of years, it is probable that many planetary systems exist throughout our galaxy and the innumerable other galaxies that are strewn throughout space.''

TELESCOPE FOR SOUTH AFRICA

WHAT will be the largest telescope south of the equator is now under final test at Pittsburgh, preparatory to dismantling it for shipment to its final home in South Africa. The new instrument, a reflecting telescope with a mirror five feet in diameter, has been built for the southern station of the Harvard College Observatory, at Bloemfontein, by J. W. Fecker. Harvard astronomers are now using it to make photographs of the stars. So far, it seems to be entirely satisfactory and free from measurable error.

The mounting of the telescope was designed by Mr. Fecker and built in his shops. The huge mirror, exceeded in size by only three others now in use, previously belonged to the Harvard Observatory, but was not satisfactory. It has been refigured in the Fecker works, and provided with a special mounting to prevent it from bending, as it was formerly thought too thin to be of use.

When erected in South Africa, the Harvard Station at Bloemfontein will have several large instruments adapted for photography of the southern skies. In addition to the big reflector, a refracting telescope, with a photographic lens 24 inches in diameter, is already in use, as well as a number of smaller telescopes.

The mirror for the world's third largest telescope is also undergoing completion here. This is the 69-inch disc made last year at the Bureau of Standards in Washington, and intended for the Perkins Observatory at Ohio Wesleyan University, Delaware, Ohio. The instrument was completed with the intention of using a 60-inch mirror. As the Bureau of Standards scientists succeeded in making a bigger disc than anticipated, Mr. Fecker has also built a new tube for the telescope, to use the mirror to its full advantage.

Mr. Fecker is the successor of John A. Brashear, one of the most famous makers of large telescopes and lenses.

PHENOMENALLY SLOW BREATHING

A PHYSIOLOGICAL celebrity, a young woman physiologist who breathes only three to five times a minute, has been the object of great scientific interest and public curiosity during the Carnegie Institution of Washington's annual exhibition of scientific work.

The average adult breathes fifteen to eighteen times a minute, and the extremely slow normal breathing of the young woman, now an assistant in physiology in Goucher College, Baltimore, is considered by Dr. Francis G. Benedict, of the Carnegie Institution's Nutrition Laboratory at Boston, to be absolutely unique.

Not even ill patients in hospitals who exhale and inhale ten times a minute approach the usual rate of respiration of this physiologist who, while willing to aid science by studying the cause of her unique ability and demonstrating it to the public, desires to remain anonymous in printed reports.

Her unique rate of respiration was discovered about five years ago when as a student of physiology at Mt. Holyoke she noted that she did not breathe as fast as her fellow students. The phenomenon came to the attention of Dr. Benedict, a leading research worker in the field of human physiology. In lecturing to some 70,000 physicians in some 20 cities of Europe he tried to find a similar case. A thorough search of the scientific literature was also made. No other instance of such slow breathing has been found.

The depth of the breathing is greater than normal. She inhales three pints of air at a time whereas ordinary people take in and let out only one pint. Her lung capacity, however, is normal and not larger than that of the average person. The air passing through her lungs is normal in amount and the amount of oxygen she extracts from it is also normal.

If she were a singer, she would be able to hold her notes a phenomenally long time. Dr. Benedict has urged her to attempt singing as an experiment, but her interests lie in the field of scientific research rather than in music. If she were a sprinter, which she is not, she would probably be able to run 200 yards on a single breath whereas the ordinary runner completes a hundred-yard-dash in one intake of air.

In the demonstration, the young physiologist wears a special form of respiration mask, like an inverted bucket which fits over the head. A rubber collar closes the open end, while a celluloid window permits her to see what is going on about her. Air enters through a tube at the top, and is sucked out through a tube at the side by means of a small electric blower. The exhaust air is drawn through chemicals to absorb the carbon dioxide breathed out of the lungs. After being thus purified, the air goes back to the mask and is breathed over again. A collapsible cylinder, like a city gas tank, goes up and

down as the subject breathes out and in, while a pen attached to it writes a permanent record of the breathing volume on a revolving paper cylinder.

As the substance of the body burns to produce heat, oxygen is changed into carbon dioxide, and so the volume of air in the apparatus is gradually reduced. For every liter of oxygen that is used, about five calories, or heat units, are produced. Therefore, by measuring the rate at which oxygen is used up, the heat produced by the subject can be measured.

HOSPITALS FOR PATIENTS OF MODERATE MEANS

A DEFINITE trend toward increasing accommodations and lowering costs in hospitals, designed for the benefit of patients of moderate means, was observed in a study of hospital service just completed by Dr. Niles Carpenter, of the Committee on the Cost of Medical Care.

Whether or not the patient of moderate means will be able to pay for his hospital care if all hospitals adopt these new policies can not yet be stated. A satisfactory answer to this question will be forthcoming after a few more years' experience with the new policies.

The study was based on conditions in 270 hospitals. Sharp distinctions between the classes of hospital patients are being broken down, much as are the distinctions between classes of passengers on transatlantic liners, the study revealed.

"Passengers in the 'steerage' (that is, the ward) are beginning to receive some of the privileges heretofore associated only with the 'first cabin' (that is, the private room), and a new 'cabin class' of accommodations (the semi-private room and the small ward), intermediate in physical equipment and in accompanying privileges between these two extremes, has made its appearance."

In 1908 almost one third of the beds in the hospitals studied were in large wards. In 1928 less than one tenth were in such wards. The proportion of beds in semi-private rooms increased over the same twenty-year period from one tenth of the total number to almost one quarter of the total.

Special provisions for patients of moderate means are now included in the future building plans of many of the hospitals studied. Twenty-one institutions plan new buildings primarily for the use of such patients. The Massachusetts General Hospital of Boston plans a new "Hospital for People of Moderate Means" of 300 beds with rates varying from $6.50 per day for single rooms to $4.00 a day for cubicles.

Prices most frequently charged for beds in semi-private rooms range from $5.00 to $6.99 per day and for beds in small wards from $3.00 to $4.99. Only one fifth of the beds in single rooms can be secured for less than $5.00 a day, while about three fourths of the beds in semi-private rooms and almost all of those in small wards are priced at less than $5.00.

In the matter of extra service charges, such as for laboratory, X-ray, special nursing, operating room and anesthesia, the hospitals are working out various plans for lightening the burden these often place on patients of moderate means. Some hospitals are graduating these charges, some are eliminating them and some are placing them on a flat rate basis. Hospitals are also trying to make financial adjustments by which the total charges are reduced or placed on a deferred or installment basis of payment for patients of moderate means. These arrangements are made after careful, tactful investigation of the patient's resources and financial status.

Finally, in some hospitals a fixed limit is placed on the fee which the physician charges his patients of moderate circumstances. In other hospitals an informal understanding exists between physician and hospital to much the same effect.

ITEMS

PORTRAITS of the giant cats that once roamed North America were a feature of the annual exhibition of the work of the Carnegie Institution of Washington. Fossil finds at various places, but especially at the famous La Brea tar pits in California, have made possible the collection of an unusually complete series of skulls, representing all stages from kittenhood to old age. There are two definite types shown in the big-cat group of Ice Age time in America. One is the famous saber-tooth tiger, which used its exaggerated upper eye teeth for killing its prey and fighting its enemies. The other is a more orthodox cat, a great lion, which has a skull and tooth arrangement more like those of the present-day lions and tigers, which are primarily biting animals.

FOSSIL leaves, split out from between layers of rocks, tell of a great change in the climate of eastern Oregon since the days when it was a region of major volcanic activity several millions of years ago. The region is now one of considerable aridity, with only about fifteen inches of rainfall a year. But these rocks, now on display at the annual exhibition of the Carnegie Institution of Washington, contain leaves of sequoia, alder, tan-oak and bay, indicating the type of forest found now on the northern coast of California, which receives 45 inches of rain each year. The leaves and other plant parts were caught in falls of volcanic ash, which preserved their imprints while they were compressed and hardened into stone.

MARMOTS, better known as "woodchucks" and "groundhogs," are disappearing in California's Sierra Nevada, according to Dr. H. C. Bryant, of the University of California, writing in *Yosemite Nature Notes.* These animals ten years ago were exceedingly common near timber line throughout the central Sierra Nevada. According to Dr. Bryant, cycles of scarcity and abundance are known for almost all rodents. The gray squirrel suffered diminution as the result of a severe disease several years ago, until not one was to be found on the floor of Yosemite Valley. At present it is coming back to its former habitat, at least six different squirrels having been counted there last summer. Now it is the marmot that is scarce throughout the whole Yosemite National Park region, but no one knows the real reason for the scarcity.

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